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PROFESSOR PERRY'S INAUGURAL ADDRESS.

THE title of Professor in these days may mean anything or nothing. By some people it is regarded with awe, by others with derision, but when followed by the words "John Perry," it never fails to awaken the warmest feelings of affection and respect.

Presidential addresses are not open to discussion, but probably no other sort of literary production ever meets with more vigorous criticism in the Press.

Prof. Perry, in his address to the Institution of Electrical Engineers, has not hesitated to speak his mind very freely, and although in all probability he will be quite as freely criticised, he has such a stronghold on the goodwill of the entire Institution and of very many outside it, that he runs no risk of having to read any remarks which would cause him the slightest annoyance.

As one reads the President's breezy address one can scarcely help wishing that for once he had cast aside the orthodox form, and given us in lieu thereof a lecture on the "new mathematics." The old school of mathematics calls forth Prof. Perry's strongest expressions of contempt. He says "As for the man who does understand electrical problems, he remembers that there was a something called a study of mathematics at his school, that he passed certain examinations with much difficulty and tribulation, and that the subject had no real meaning to him even when he was supposed to know it, and he now hates the sight of anything that looks like mathematics. I tell you, gentlemen, that there is only one remedy for this sort of thing, just as the antiquated method of studying arithmetic has been given up, so the antiquated method of studying other parts of mathematics must be given up;" and yet, only two minutes previously, he says, "I feel a sort of degradation every time that I hear a clever old member of this Institution sneering at mathematics;" but obviously the clever old member was only sneering at the antiquated mathematics, and he will be among the first to bless the name of Perry, who aims at making our mathematical tools as sharp and handy as those of the pattern maker.

But he does more than that; the tools he is providing us with are not merely sharp and handy, they are instruments of precision; he is the Whitworth of our wits, and the sooner we recognise that our wits require tools quite as much as our hands, the sooner shall we give our progressive President *carte blanche* to provide them.

We have amongst us many a "born engineer" whose brain is a sort of self-acting slide rule; he sees, as it were, the end from the beginning, and is scarcely conscious of his mathematical processes, but the mathematical processes are there, though he cannot display them on paper with an exhibition of the orthodox symbols, but, in partnership with

D

vertical stem of which can be turned on a stand. 2 claims.

the carriages on the train. 9 claims.

Perry, the thoughts of these men would crystallise into definite recognisable shapes, and would appear as clear and convincing to others as they now do to their authors.

We often hear and read of "Applied Mathematics," but mathematics cannot be bought by weight ready applied; they can only be applied by the exercise of brains, and usually it takes more brains to apply than to acquire mathematics.

Although Prof. Perry is so active and helpful in trying to improve this imperfect world, and in stimulating and equipping others for the same task, the goal of "perfection" has no charms for him. "Of all ideas, surely that of having reached perfection is most hateful; the idea of exact knowledge, that nothing is unknown, that there is no need for thought and therefore that to think for oneself is a sin." No doubt Prof. Perry is right, but it seems rather dreadful that we should go on toiling towards a goal which, after all, is undesirable. Probably the man who, with great labour and at the risk of his life, reaches the summit of the Jungfrau, feels a sense of intense disappointment when he realises that the best thing he can do is to come down again; and yet there is no danger whatever of the world becoming perfect, because the very state of perfection would involve new imperfections. Imagine a world in which all women were perfect, and consequently all alike; it is obvious that, in spite of certain charms which that world would undoubtedly possess, it would be deadly dull, and therefore, in some respects, less perfect than the one we live in. But this idea brings us at once to an elucidation of some of the troubles with which the learned Professor occupies himself. He has much to say against erroneous opinions on the subject of science, theory, and mathematics, but surely he would have nothing to say on these heads if our language were perfect, and the names attached to those ideas were not more or less ambiguous.

It is this ever-recurring ambiguity, or insufficiency of expression, that leads to nine-tenths of the talking and writing of which this nineteenth century is so full. The English language is replete with quagmires and pitfalls. Words derived from pure sources have been gradually corrupted by popular interpretation, until we need a distinctive mark to indicate whether the word is to be accepted in its pure sense or in its degraded sense.

The President, like so many others who have gone before him, has endeavoured to define the profession of electrical engineering, and although, from one point of view, he has succeeded, yet it is quite probable that it will have to be bound up with other definitions before the description is complete. One cannot help feeling that the Professor's "engineer" owes his principal qualifications to Nature, for he says, "The engineer must be a real man; he must possess individuality and the power to think for himself." Training may do a little towards producing this result, but not much more than a dressmaker can do towards improving a bad figure.

Prof. Perry seems to recognise this view of the question very thoroughly, for he says: "A man, who is permeated by theory, whose theory is so much a part of his mental machinery that it is always ready for practical application to any problem, he is the real engineer; eighty per cent. of the men who pass examinations in mathematics, mechanics, and electricity have very little of this theory. Fifty per cent. of the writers of letters in the engineering journals in which mathematical expressions occur have almost nothing of this theory in their possession. It is unknown to foolish men."

One can scarcely resist the conclusion suggested by Prof. Perry, that only one in five of our engineering students is built of the stuff suitable for producing engineers. It is also quite evident that the "theory" which Prof. Perry commends is not the theory which is so often spoken of with contempt. It is altogether a superior article. It takes into consideration every factor of the problem. Of such theory it is impossible to form a too exalted opinion, provided that the almost equal claims of practice are not lost sight of. It is quite natural that professors should take a somewhat one-sided view of the profession of an engineer, but in everyday work it is only in the case of some highly specialised men, such as that, for instance, of the late Dr. Hopkinson, that the purely professional side can be dissociated from the practice of those things which are commonly covered by the general name of business.

Now, the "business" of an engineer is nearly as complicated as the purely theoretical side of it. This "business" requires both time and perseverance for its acquisition, and it is a sad fact that many intelligent and earnest seekers after engineering fame have grown disheartened, and have failed, simply because at the outset they did not realise what a sea of drudgery they would have to wade through before their excellent theoretical attainments would become marketable commodities.

In our opinion, with all respect to Prof. Perry, it is important that youths should take their workshop training early. It enables them to weigh up the position before their ideas of life become crystallised, and, moreover, it ensures their acquisition of not the least important part of their training at a time when they are not in a position to exercise that part of their will (if it may be so called) which is influenced by idleness and the love of a pleasant life.

There is, of course, a great deal to be said on both sides of the question, but when once it is realised that a thoroughly practical training is absolutely essential to the making of an engineer, the desirability of doing that which is necessary now, instead of putting it off to a more convenient season, will more strongly than at present commend itself to parents and other guardians of youth.

Apart from the difficulty of coaxing nature into providing us with first-class raw material for the manufacture of engineers, the one great difficulty consists in this, that there is so much to learn and so little time to learn it in.

The Motor Car Emancipation Act.—The fourth anniversary of the inauguration of the Locomotives on Highways Act of 1896 was celebrated by a tour from London to Southsea and back. The tour was organised by the Automobile Club, and extended from November 10th to 12th. A large number of vehicles took part in the run, but nearly all were driven by petrol, only two electrical ones being entered. The Mayor of Portsmouth and a reception committee received the party at the Town Hall steps; the committee afterwards decided to which vehicle should be awarded the cup presented by Mr. Alfred Harmsworth for the one which, on its arrival, looked cleanest and smartest. The silver cup was won by Mr. Henry Edmunds, for his Daimler car, and it was handed to him by the Mayor at the dinner held on Saturday evening at the Esplanade Hotel, Southsea.

THE TELAUTOGRAPH.

Some weeks ago we were invited to be present at a demonstration of a new writing telegraph, but on our arrival we found that the invitation was somewhat premature; owing to certain considerations connected with patent rights, or rites, we were unable to do more than see the instrument at work.

Last week, however, we were informed that the objections to publication were removed, and we had the pleasure of examining the details of the telautograph *without* the cover on.

Compared with the numerous attempts, many of them of exceeding ingenuity, which have been made to construct an instrument capable of reproducing simultaneously a true *fac simile* of the handwriting of a distant operator, the new form of the telautograph appears to us to constitute an immense step in advance. The principle is practically the same as that of Prof. Elisha Gray's original instrument, but the mode of carrying it into effect has been greatly improved.

The transmission line must, as before, consist of a complete metallic circuit, provided with an earth connection at each end. The transmitter is combined with the receiver in each instrument, the former presenting externally a portion of a roll of paper upon which the outgoing message is written, and the latter a similar paper surface, nearly vertical, upon which the incoming message is recorded. A telephone of the usual table pattern, resting upon crutches at the side of the instrument, forms part of the apparatus, and may be used alternately with the telautograph, but not at the same time.

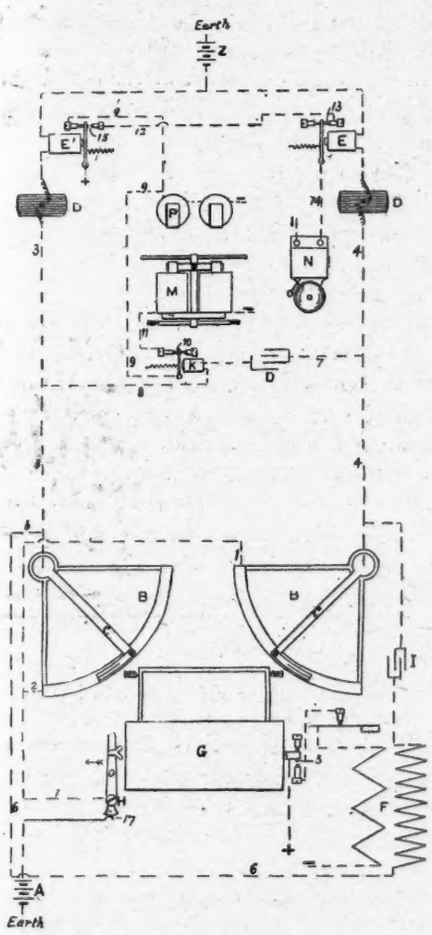


Diagram of Connections.

The connections of the transmitter and distant receiver are shown in the above diagram, it being understood, of course, that both sets are installed at each station. The arms of the rheostats, C C, are connected by a pair of light links with universal joints to the point of the pencil. Thus, every movement of the latter, in whatever direction, causes one or other, or more often both, of the arms, C C, to move through a corresponding angle, inserting more or less resistance in series with the line wires 3 and 4 respectively. At the distant station these wires are connected through two "swinging coils," D D, to earth, the circuit being completed through the two local batteries in series and the earth plates. The coils, D D, are of very light construction, and oscillate between the poles of two electro-magnets with fixed iron cores, exactly similar to the electro-magnetic system of a d'Arsonval galvanometer or a "moving-coil" voltmeter.

The spindles of the coils carry arms, to the ends of which are attached two very light links carrying a small inking point at their lower end—the system being, therefore, quite analogous to that at the transmitting end. The coils respond instantly to the varying currents flowing through them, faithfully reproducing with the pen the motions of the distant writer's pencil.

It is a treat to see this operation in progress, the pen writing quickly, hesitating as the writer ponders over his next word, dotting its *i*'s and crossing its *t*'s, and darting into the ink-well when necessary, as though impelled by an invisible hand; and, indeed, so it is!

We have, however, but touched upon the subject as yet. It remains to be explained how the pen is lifted off the paper, and supplied with ink, how attention is called, and so on.

Considering the diagram more in detail, it will be seen that when a message is in course of transmission, current flows from battery A through a switch H and wires 1 and 2 to the rheostats B B, thence through the brushes and arms C C, to the line wires, 3 and 4, operating the coils, D D, as described above; passing through the relays, E′ and E, the current goes through the battery, Z, to earth, and so back to the home station.

An induction coil, F, with vibrating contact breaker, is controlled by the slight vertical movement of the platen, G, which is pressed down by the pressure of the pencil and completes the primary circuit through contact 5 (shown on its side for clearness). This causes alternating currents to pass through the condenser, I, to line 4 and by wire 6 to line 3. Owing to the great self-induction of the coils, D D, and relays, E′ and E, at the receiver, these alternating currents pass principally between lines 3 and 4 by wire 7, condenser L, small relay K, and wire 8, causing the relay, K, to operate the pen lifter, M, by interrupting a local current through wire 9, contact 10, and wire 11; by this action the pen is allowed to come in contact with the paper. The relays, E′ and E, are operated by the weakest line currents, E′ controlling the paper shifter P, and opening the local circuit through M when the instrument is not in use. The relay E, in conjunction with E′, controls the signal bell N; for this purpose the transmitter is fitted with a push key, not shown on the diagram, which breaks line 3, and puts the battery A direct to line 4, thus allowing a local current to pass through contact 15, wire 12, contact 13, and wire 14 to bell N. The lever, O, at the transmitter is operated by the pencil, and is mechanically connected with a paper shifter. Its movement also operates a contact at 17, thereby breaking connection with the lines when it is pushed in the direction of the arrow, and actuating the paper-shifting apparatus at the receiver. The + and — signs indicate terminals which are connected to the respective poles of the local batteries, A and Z.

The paper shifter, P, at the receiving end consists of an electro-magnet with two armatures; one, a small one, actuates a little clutch which seizes the paper, while the other pulls it forward a set distance, exactly equal to the amount of feed of the mechanical paper shifter at the transmitter. At the end of the feeding stroke the movement of the armature causes a high resistance to be inserted in the circuit of the electro-magnet, so as to reduce the current to a very small value. The electro-magnet continues to hold up the armature as long as the main circuit is complete. The writing space allows of three or four lines 5 inches wide being written without interruption; the pencil is then pressed against the V-notch in the lever O, causing it to operate the mechanical paper-shifter in the writer's

electricity have very little of this theory. Fifty per cent. of the

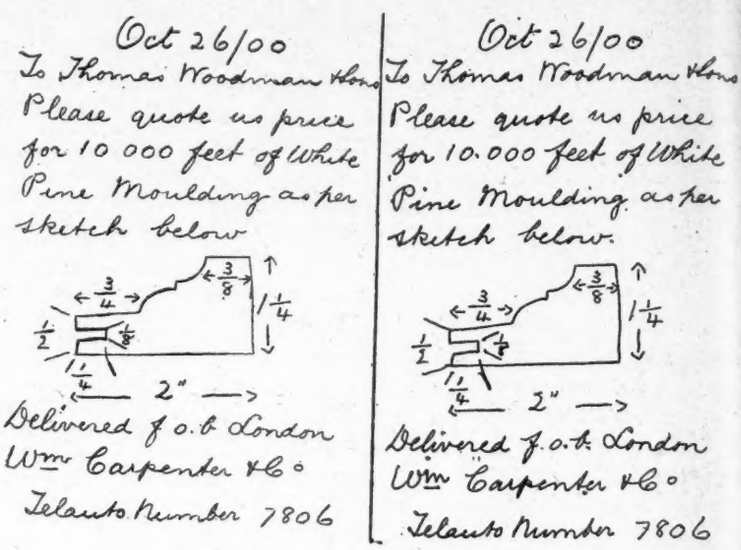
Saturday evening at the Esplanade Hotel, Southsea.

instrument and to break the circuit at H. This drops the armature of the paper-shifter, P, and as the lever, O, springs back and closes the circuit the armature is again pulled up, feeding the paper forward at the distant end. The act of breaking the circuit, as mentioned above, also causes the pen to dip in the ink-well.

The telephone connections are of the usual kind and need no description.

We should add that when the instrument is done with, the pencil is pressed into a cup on the top of a press-button, which puts the two local batteries in opposition, thus preventing them from running down. If this is not done, an alarm bell rings when the hand is taken off the desk. The resistance of the line may be, say, 300 ohms; that of the swinging coil is 185 ohms, of the relays, E', E, 20 ohms, and of the rheostat 7,000 ohms. The last is a very neat device, consisting of a large number of thin German-silver sections, built up like a commutator, with paper insulation; coils of fine wire form the connections between adjacent sections, and the whole constitutes a very neat and compact appliance. A light steel brush slides over the polished surface of the rheostat with negligible friction; no difficulty whatever is felt in writing or sketching, as is evidenced from the samples appended.

The company works under a license from the Post Office, and is authorised to instal the apparatus on Post Office telephone circuits, and on any private line. The advantages of the telautograph—its silence and simplicity, the possibility of transmitting signed instructions, &c., and the saving of time—all these, and others, are sufficiently indicated by the word itself, "writing at a distance."



As written. As received.

Fac Simile of Actual Writing.

GLASGOW TRAMWAYS.

A great deal has been said and written from time to time in connection with the Glasgow Corporation tramways, by way of wonder and admiration at the financial results of municipal working therein exemplified.

Every year, so it is said, a substantial net revenue balance has been shown; and this, if so allocated, would, of course, make a handsome contribution from the tramway undertaking to the general rate.

Perhaps very few individuals, if asked, could say—taking the country over—either what has been done or what should be done with net revenue balances of this kind from a municipal undertaking; and in reply to the first of these points, it may, therefore, be worth while reminding our readers that the Glasgow tramways have not paid over any surplus revenue whatever towards the relief of the general rating, or, indeed, made any payments whatever for the benefit of the ratepayers generally, excepting an annual contribution by the Tramways Committee to the "common good" of amounts commencing at £9,000 and rising up to £12,500 (and in the future £15,000) as a sort of wayleave for use of the streets.

It seems to have been the rule, since the Corporation took over the tramways, for the net revenue balances to be put to reserve fund, which now amounts to a sum of £169,492. The Tramways Committee, which has already spent some £389,402 on reconstruction work for electric traction, now proposes to utilise the whole of this reserve fund for completing the present network and for meeting losses on realisation of horses and rolling stock. The Committee has, in addition to this reserve fund, unexhausted borrowing powers to the extent of £308,205; but as they have overspent on capital account about £244,801, they will only have a gross amount of about £233,000 to pay for everything involved in the adaptation and conversion of the present system.

Apparently this sum will not be sufficient, and the Committee therefore proposes to ask Parliament in the ensuing session for powers to borrow as much as a million and a quarter, presumably to cover all further expense in regard to the existing network, as well as the outlays which will be necessary upon the extensions outside Glasgow boundaries.

The total indebtedness of the Glasgow municipal tramway undertaking will then amount to not less than £2,560,000, assuming the full borrowing powers are exercised, as seems probably advisable and necessary.

The mileage for this expenditure it is not easy to state or even to estimate, as it will, of course, depend on the outside extensions that are actually built; but for the present expenditure the mileage is approximately 83½ of single track, and the capital outlay about £16,000 per mile of single track, assuming that none of the new borrowing powers will be exercised for the completion of the present system. This is, of course, after making due allowance for the amounts already set aside for depreciation, &c.

THE ELECTRICITY WORKS OF CHÈVRES (GENEVA).

(*Continued from page* 709.)

The switchboard is constructed entirely of incombustible material. The iron framework is covered on the side facing the machinery room with panels of white marble, which only carry the instruments, the wooden handles of the switches, and the wheels of the exciter rheostats. The division of the panels corresponds to that of the circuits, so that each machine or each feeder has its special panel.

The board is 26·01 metres long, and comprises 34 panels. All parts in contact with high tension are placed out of reach of the hand or behind the board; particularly worthy of notice is the arrangement of the high tension switches, placed at the top of their respective panels and worked from a distance by a double wooden handle, acting on a chain by means of a toothed wheel. The chain works a second wheel keyed to a spindle, which carries eight contacts on solid insulators. These eight contacts engage eight copper jaws, and can be released by a rotation of the supporting spindle. By this means eight breaks can be made, two in each conductor. To stop all chance of sparking between the jaws these are separated by thick slabs of slate.

The switch-fuses placed behind the board each consist of a fuse in a thick porcelain tube; the whole is carried on the board between two jaws, which makes the apparatus removable and permits of their being used as circuit breakers and being replaced with ease.

All the usual operations are done from the side facing the machinery room; behind the board is a passage 1·25 metres wide, to which access is only allowed to the chief engineer, or under his surveillance.

The scheme has been made as simple as possible; yet the requirements of the distribution made it necessary to adopt two alternating systems, one at 2,750 volts for the underground network, the other at 5,500 volts for the overhead lines. The board is thus divided into three parts:—

1. Continuous current.
2. Alternating current, 2,750 volts.
3. Alternating current, 5,500 volts.

1. *Continuous Current.*—This section comprises 6 panels, arranged as follows, commencing from the right—Panels 1, 2, 3, 5, 6, corresponding to the exciters. Panel 4 serves for the lighting and power circuits of the works.

2. *Alternating Current, 2,750 Volts.*—Panels 7, 8, 9, 10, 11, 15, 16, 17, 18, 19, 20, carry the apparatus of 11 alternators at 2,750 volts; panel 12 feeds a group of transformers of 1,000 KW., 2,750 to 5,500 volts, which permits of the two systems of distribution being connected. Panels 13 and 14 are for the underground feeders.

All these panels are connected by a system of bus bars in ring form, and provided with switches. This arrangement permits of the current being broken in any panel without it being necessary to stop the supply.

A third bar to one of the underground cables also permits of the output being split into two parts. The alternators can, as required, be switched to one or the other system, depending on the position of the switches. It is thus possible to separately feed the larger part of the power circuits, and also obtain an increased lighting service.

3. *Alternating Current, 5,500 volts.*—Panels 21, 22, and 23 correspond to alternators Nos. 12, 13, and 14. Panel 24 is reserved for the fifteenth generator. Panel 25 is similar to panel 12; it receives the current at 5,500 volts of the transformer station. Panels 26 to 34 are for the 5,500-volt overhead feeders. The bus bars of the 5,500-volt system are also in ring form, with switches at intervals.

Each alternator has an ammeter in each phase, one voltmeter, and one synchronising lamp. Station voltmeters indicate the voltage of the bus bars; also two voltmeters on low tension pilot lines allow the voltage to be regulated according to the load in the town.

Travelling Crane.

The handling of large pieces of machinery, either for erection, for examination, or for repairs, is effected by means of a winch on the travelling crane, made by Messrs. Faesch and Piccard, of Geneva. The lifting can be effected by hand or by means of a motor of 9 H.P., fixed on the bed of the winch. The gearing is of the "sun and planet" type.

The capacity is 30,000 kilos.; the speed of lifting with the motor is 27 metres per hour, and by hand only 1·5 metres per hour. The movements both of the traveller and of the winch are controlled by special gearing, moved by an endless chain, and entirely by hand. The speed of the traveller is 0·6 metre per minute, and of the winch truck 1 metre per minute.

The chain for lifting carries a hook for 30,000 kilos., and there is another hook capable of lifting 15,000 kilos. The lifting speed of this second hook is, of course, double that referred to above.

Feeders.

Underground Lines. No. 1.—As the transmission of electrical energy from Chèvres to Geneva is on the two-phase system, the feeders are two in number, each with four conductors. The total distance is 5,825 metres, and it is divided into five sections, of which the ends are brought into sub-stations. The construction of this line is original, and was the idea of M. Graizier, chief electrical engineer. It consists of a trough of concrete, in which the four conductors are buried in bitumen concrete and kept at a fixed distance from each other by special bricks placed 0·5 metre apart, and having each two channels in which the conductors are laid. The bitumen concrete is a mixture of bitumen produced by the distillation of oil heated to 200°, and small gravel completely desiccated.

In order to make it more plastic, the bitumen is mixed when hot with a certain proportion of vaseline; thus prepared, it may be said to constitute a stable compound, which fills up the interstices of the gravel and fills the trough whilst surrounding the conductors. The mixing with the gravel was effected on the site in boilers, and the concrete was run, whilst hot, into the trough immediately after the laying of every section of the conductors. The whole is covered with a layer of concrete and with a cover of cement. Each conductor comprises seven copper cables, each of these consisting of seven strands of 0·0036 metre diameter, the section of a cable being, therefore, 70 square millimetres, and of a conductor 490 square millimetres. The division into five sections as aforesaid by sub-stations permits of the easy discovery of possible faults in the line. The sub-stations also contain the necessary transformers for converting to low tension the energy required along the line of route. The sub-station at the end of the line also includes the switchboard for controlling the different circuits of the town.

In spite of all the precautions taken, certain foreign matter got into the bitumen at times, or even a little moisture, particularly when the line was being laid in rainy weather, and this necessitated some repairs during the early periods of working.

No. 2 Line.—This was completed in 1897 by the laying next to the first line of four lead-covered armoured cables, each of 2 × 150 square millimetres section.

Overhead Lines.—The consumers on the left bank of the Rhône are fed by a feeder comprising four wires, each of 97·5 square millimetres section. Those on the right bank are served by a feeder, also of four wires, each being 28 square millimetres in section.

In the course of construction of these lines and their branches, many small existing installations had to be bought out.

The development of the feeders and their extension is shown by the following table:—

Total Length of Feeders in Metres.

	1896.	1897.	1898.	1899.
Underground ...	18,552	33,801	35,771	38,298
Overhead ...	10,425	37,311	43,145	43,145
Total ...	28,977	71,112	78,916	81,443

The output of the Chèvres installation has been as follows:—

1896	1,342,362 KW.-hours.
1897	3,669,876 ,,
1898	9,517,262 ,,
1899	28,066,483 ,,

The principal users of energy are factories for the manufacture of carbide of calcium and chemicals, various works, the tramway company, and the lighting service of the town and of many communes.

(To be concluded.)

ELECTRO-CHEMISTRY.

The International Congress of Applied Chemistry at Paris.

(*Concluded from page* 617.)

In our issue of October 19th we gave a complete list of the papers and addresses presented at the International Congress of Applied Chemistry in Paris up to July 25th, referring, in some instances, to their main points. We will now refer briefly to the remaining papers, which were read before the Electro-Chemical Section during the last three days, namely, the 26th, 27th, and 28th.

M. A. Minet, in his report upon "Electro-chemistry in 1900," showed the actual condition of the electro-chemical industries in France and in other countries. His report was divided into three parts. The first was purely historical. In the second part he gave the names of the various electro-chemical works in France and in other countries, showing their situations and the amount of power being used in

present system.

replaced with ease.

each. The total number of works was given as 161, out of which 93 are in France, and may be classified as under :—

Refining of copper	4
Electro-plating	9
Electro-metallurgical (by dry methods)	5
Carbide of calcium	19
Carborundum	1
Chlorate of potassium	3
Soda, chlorine, and derivatives	6
Ozone	3
Manufacture of materials and of special apparatus for electrolysis	5
Carbons for electrical work	3
Manufacture of primary batteries	6
Manufacture of accumulators	19
Manufacture of special dynamos for electro-chemistry	7

The last part was devoted to a review of the various works bearing on the subject.

M. Peyrusson read a paper upon an electrolyser which automatically produces a uniform and regular action during electrolysis.

M. Clerc communicated a report upon "Electric furnaces and the production of metals and alloys in the electric furnace," in which he mentioned his own researches upon the production of ferro-chromium.

M. Lebeau gave the results of his researches upon "The industrial preparation of silicon." He has produced by the reduction of silica with carbon in the electric furnace silicon of 98 per cent. purity, and claims that his method of production is capable of being industrially applied, and, moreover, that good silicon would find a ready market for the manufacture of ferro-silicon in the steel industry.

M. Palmaer read a paper upon "The utilisation of motive forces in Sweden," in which he said that that country possessed already four works manufacturing calcium carbide, two chlorate of potassium, and one potash and chlorine.

M. Zenghelis made a communication upon "The variations of electrical potential during chemical reactions," in which he discusses Nernst's formula for the calculation of potential when a sheet of metal is placed in a solution of its salt at a known temperature and concentration, and also a method, similar in principle, by which he estimated the quantity of sugar present in urine and which he found approximated to 1 per cent.

M. Hubon described "The preparation and properties of acetylene black," which he regards as an industry capable of development.

M. Hollard demonstrated "The principles of electrolytic analysis and the analysis of commercial copper," when he separated several metals by means of fractional electrolysis.

M. Marie described "A method for the electrolytic reduction of lead from its insoluble compounds," in which he first precipitates the lead as sulphate or chromate, and then dissolves in nitric acid in presence of ammonium nitrates; he then electrolyses this solution, and obtains the lead upon the cathode.

Dr. Max Leblanc discussed his "Proposition for the designation of the fundamental electro-chemical units." He recapitulated the work which has been done in Germany and Russia, and recommended the following definitions :—

1. *Conductivity.*—A body possesses unit conductivity when a column of 1 square centimetre cross-section and 1 centimetre length has a resistance of 1 ohm.

2. *Molecular conductivity* is the conductivity as above defined, divided by the number of gramme-molecules dissolved in a cubic centimetre of solution.

3. *The concentration equivalent* is the number of gramme-equivalents dissolved in a cubic centimetre of solution.

4. *The dilution equivalent* is the reciprocal of the concentration equivalent.

5. *The conduction equivalent* is expressed by

$$\Delta = \frac{K}{n},$$

where K is the electric conductivity (specific), and n is the concentration equivalent.

6. *The ionic velocities* are expressed in centimetres per second for a difference of potential of 1 volt per centimetre.

It was finally decided that the question of the adoption of these or other definitions should be discussed at the Physical Congress.

M. Verbno-Laszgynski communicated a paper upon "A zinc-alkali-nickel accumulator."

M. Paul Lacroix gave a lecture upon "Apparatus for the 'Héleogène' system of Capelle-Lacroix" for the production of acetylene gas by the slow feed of water into a generator containing carbide of calcium.

M. Javal showed an acetylene generator of his own design which contained also an automatic purifier.

M. Hubon asked what conditions the consumers can demand from the manufacturers for the supply of calcium carbide.

M.M. Moissan, Gall, Lunge, Bullier, Lacroix, Hubon, Strauss and Lebeau were appointed to hold a commission to inquire into and consider the limiting amounts of impurities which should be allowed in commercial calcium carbide and acetylene.

M. Christomanos described a very curious experiment showing "The action of magnesium in burning on the surface of marble" which produced a reduction and a black deposit to a very remarkable depth in the marble.

M. Siedmann showed, in the name of M. Otto, some ozonizers, being the designs of the latter.

M. Stock described his researches corroborating M. Moissan's upon the silicides of boron.

M. Moissan presented a paper on his "Recent Reseaches on the Properties of Fluorine," mentioning the action of fluorine and hydro-fluoric acid upon glass, and the production of ozone by the action of fluorine upon water. This lecture was accompanied by experiments, one of the most interesting being the liquification of fluorine.

M. Defacqz read a report on "The methods of analysis of commercial aluminium."

M. Fischer presented a report upon the "Preparation of tetra-sulphate of lead, of the double salts of the alkalis, and of the tetravalent salts of lead."

MM. Meslans and Camille Poulenc showed "An industrial apparatus for the preparation of fluorine."

M. Guichard described "The preparation and melting of molybdenum," which he obtained in the electric furnace by the reduction of natural bisulphate of that metal.

M. Lebeau, in the name of M. Moissan, communicated a paper upon "Phosphide of calcium," and afterwards described his work on "The arsenides of the alkali earths."

M. Macé showed "An apparatus for the production of acetylene of his own design.

CURRENT SPECIFICATIONS.

XXXVI.—NEWCASTLE-ON-TYNE STREET LIGHTING.

SUMMARY.

Scope of Contract.—The supply and erection of 200 arc lamps for street lighting.

Type of Lamp.—10-ampere direct current arc lamps to burn 10 in series on a 500-volt tramway circuit.

Number of Hours of Burning.—Each lamp to burn not less than 36 hours without recarboning.

Class of Carbons.—The carbons to be so proportioned that positive and negative are of equal length, and burn at same rates.

Method of Suspension.—134 to be fixed in suitable frames on the tops of tramway poles placed centrally in respect to the rails, and 66 on brackets secured to the tops of side suspension poles.

Types of Frames and Brackets.—To be either similar in design or equal in value to the design shown on the drawing issued with the specification.

Type of Substitutional Resistance.—A suitable substitutional resistance to be provided with each lamp capable of being automatically switched into circuit when, from any cause, the lamp fails to maintain its arc.

Other Resistance.—One line resistance to be provided for each circuit of 10 lamps.

Switches and Fuses to be Supplied.—Two switches and fuses to be supplied for each of the 10 circuits, one switch and one fuse being placed in the lamp-posts nearest the ends of the circuits.

Cables to be Supplied.—All connecting cables between resistances and lamps and between adjacent lamps on the same circuit. These latter cables to be drawn into conduits provided and laid by the Corporation.

Class of Insulation.—To be either insulated with india-rubber and then sheathed with lead, or insulated with vulcanised bitumen and manufactured by Messrs. Callender's Cable and Construction Company.

In order to make it more plastic, the bitumen is mixed

their situations and the amount of power being used in

Spares.—Spare parts as specified to be supplied.
Specified Date of Completion.—All brackets to be fixed in five months, and the work completed in eight months from date of order.
Penalty for Late Completion.—Power reserved to Corporation to have work completed by other parties at contractor's charge.
Stipulations as to Removal of Foreman.—Satisfactory.
Stipulations as to Wages paid to Workmen.—None.
Arbitration Proposals.—Unsatisfactory, see comments below.
Specified Terms of Payment.—60 per cent. on delivery, 20 per cent. on completion, 15 per cent. on satisfactory completion of tests, 5 per cent. 12 months later.
Date for sending in Tenders.—November 21st, 1900.

The specification for this work has been prepared by Mr. Charles Hopkinson, M.I.C.E., and it is expressly stated in the general conditions that he may act through his partners, Messrs. Hopkinson & Talbot, or through the resident engineer, Mr. Le Rossignol, appointed by the new Tramways Committee of the Corporation.

The work required to be done is the supply and erection of 200 double-carbon 10-ampere arc lamps in frames or on brackets fixed upon the poles employed in the overhead equipment of the tramways.

It will be remembered that there are two companies supplying electrical energy under Parliamentary powers in the borough of Newcastle-on-Tyne. By private arrangement sanctioned by the Corporation a division has been made of the city, and each company appropriates as its own area of supply one portion. Neither have been able to secure any extensive contract from the Corporation for street lighting, and consequently the local authorities have taken advantage of the introduction of electric trams owned and worked by themselves to arrange for the public lighting by means of arc lamps on the lines of route. The energy will be supplied from the Corporation power house. The lamps will be arranged in 20 circuits of 10 lamps in each between the nearest feeding point to the commencement of the circuit and the rails, one of the requirements of the specification being the careful bonding of the earth potential ends of the 10 circuits to the rails. Substitutional resistances capable of being automatically switched in should the lamp to which it is connected fail, are to be supplied with every lamp, and in addition a line resistance with two switches and fuses for each circuit.

When completed this will form one of the most extensive systems of public lighting by means of arc lamps in this country supplied from a tramway power station not supplying energy for private lighting.

It is specified that the whole of the work, except glass globes and cables, shall be maintained against defective workmanship and material for 12 months, and the cables for a period of five years after they are first used. As this is contrary to the recommendations made in the recent circular issued by the Cable Makers' Association, we expect that there will be a general refusal on the part of the cable manufacturers to comply with this requirement.

Dealing with the general conditions, we have the usual stipulation that:—

> The general and detail drawings, together with the specification and these conditions, are the data upon which the contract is founded; and *no errors, omissions, or discrepancies herein shall in any way annul or invalidate the contract;* and each of the said drawings, specifications, and conditions respectively shall be taken and construed according to its true intent and meaning, although every part of the work may not be delineated or described therein.

While it is agreed that:—

> The Corporation will afford to the contractor all reasonable facilities for the convenient execution of the work so far as the same shall, in the opinion of the engineer, be consistent with the due progress and management of the electric works of the Corporation, and with the terms of the contract.

As at present drafted in the clause dealing with the matter, the power of the engineer to vary the amount of the work to be done is unlimited, and some tenderers may prefer to limit this within certain degrees, say, 20 or 30 per cent. of the scheduled quantities.

The following clause deals with the liabilities of the contractor respecting accidents:—

> *The contractor shall take the risk of, and be answerable for all accidents and damages, personal, consequential, or otherwise, that may occur during the progress and until the expiration of the period of maintenance* defined by the specification attached hereto, and shall repair and make good the same from time to time *as soon as possible at his own cost and charge*, and shall indemnify and bear the Corporation entirely harmless therefrom, *unless the engineer shall be satisfied that the accident arises from a known cause other than a defect of construction, workmanship, or material, in which case the cost shall be borne by the Corporation.*

It will be noticed that the contractor is to be held liable for any accident which may occur not only during the time his employés are engaged in erecting the lamps, but *for the whole of the 12 months' period of maintenance*, unless they can convince the engineer that the fault is not due to defective workmanship. We do not consider it fair to thus throw the onus of proof upon the absent contractor; the accident may be due to carelessness or negligence on the part of one of the employés of the Corporation, and may not be detected. The contractor has no means of discovering the cause of the accident, and ought not to be held responsible unless it can be proved by the Corporation that he was to blame.

The following clauses are thoroughly satisfactory if, by the word "dismiss," is meant that the person shall be removed from doing any further work in connection with this contract.

> The contractor shall employ at his own cost and charge a competent foreman, through whom the engineer may convey the necessary instructions with reference to the due and proper progress of and the manner of executing the work, and to ensure efficient control and superintendence.
>
> The contractor shall employ in and about the execution of the work only such foremen, agents, and workmen as are careful and skilled in their various trades and callings, and the engineer shall have full power to object to and dismiss any person employed by the contractor in or about the streets who shall, in his opinion, misconduct himself, or be incompetent for the due and proper performance of his duties, and the contractor shall, without delay, replace any person so dismissed.

The want of any provision for referring any possible dispute to the arbitration of an independent authority is the principal fault in this specification. It will be seen from the wording of the clause reprinted below that all disputes must be settled by the engineer himself:—

> *In the event of any difference of opinion, doubts or disputes arising respecting the true intent and meaning of the drawings or specifications,* or these conditions, or the contract or any part or parts thereof respectively *or respecting the quality of the materials, matters and things* to be supplied by the contractor, *or the execution of the work* or any part or parts thereof respectively, *or respecting any other matter or thing whatsoever arising out of or incidental to the contract,* the same shall be and are hereby *referred to the engineer, whose award, order and decision shall be final and binding on both parties,* and the submission hereby made shall not be revoked by either party hereto, and may be made a rule of any Divisional Court of Her Majesty's High Court of Justice, at the instance of either party to the contract; and either party to the contract may instruct counsel to appear and consent to such rule on behalf of the other party.

The meaning of the above is quite clear, the engineer is to be sole judge and at the same time counsel in his official position representing one of the parties to the dispute. It is not only unfair for the Corporation to place their responsible adviser in such a difficult and delicate position, but it is unjust to the contractor who is debarred from having his presentation of the case considered by an authority absolutely independent of the other party to the dispute. We trust that ere the contract is finally signed, the attention of the Council may be drawn to this manifestly unsatisfactory clause, and that meanwhile all tenderers will make a stipulation in their offer that it be amended on the lines agreed upon between the Electrical Plant Manufacturers' Association and the Municipal Electrical Association.

WIRELESS TELEGRAPHY WITH REPEATERS.

The Inconveniences of Successive Guarini Relays.

By E. GUARINI and LIEUT. PONCELET.

We know that, in a polarised relay, the armature is attracted by its core directly the first traces of a current traverse the coils of the relay. As soon as the armature has moved over it can close a local circuit, P^1. But

these or other definitions should be discussed at the Physical Congress.

manufactured by Messrs. Callender's Cable and Construction Company.

between the exact moment when the circuit, P, of the coil of the relay is closed at M, and the moment when the circuit is closed by the contact of a and b, sufficient time must elapse for the armature, A, of the relay to perform its stroke. If the circuit, P, is suddenly interrupted at M, the armature of the relay at once moves away from its core, and the circuit, P^1, is interrupted at the very moment when the armature of the relay begins its return stroke. There is thus a delay in the closing of P^1, and this delay is equal to the duration of the stroke of the armature of the relay, whereas at the time of breaking there is no delay.

This being understood, let A be a transmitting station, R a Guarini relay, and B a receiving station. Let—

t = the duration of a signal at the station A, *i.e.*, the duration of the depression of the Morse key (short for a dot, and long for a dash);

t_1 the duration of the stroke of the armature of the relay at the station R.

t' the duration of the stroke of the electro-magnet of the relay at the registering station B.

We get :—

1. $T = t - (t_1 + t')$

for the duration of the registering of the signal at B. If there are n relays between A and B, formula 1 becomes :—

2. $T = t - (t_1 + t_2 \ldots . + t_n + t')$.

In order that the registering may be conveniently effected, it is necessary that :—

$T > 0$, or $t > t_1 + t_2 + t_3 + \ldots . + t_n + t'$.

In short, if $T = 0$ or $t = t_1 + t_2 + \ldots . + t_n + t'$, the registering commences at the moment the signal ceases at A, and when, at each relay and at the receiver, the armatures of the electro-magnets leave their core. The signal will, therefore, not have time to be registered at B.

If $T < 0$ the signal will cease at A before it has been repeated to its destination; if the signal has arrived, for instance, at the relay t_{n-m}, it will not go beyond, for the end of the signal will coincide with the end of the working of the relay t_{n-m}.

The term in brackets in formula 2 increases with the number of relays; we must, therefore, increase at the same time the term t, if we wish to retain a certain value for T. A large number of relays, therefore, fatally increases the duration of a message. One of the first conditions of the employment of successive Guarini relays is the reduction of the terms t_1, t_2, &c., *i.e.*, the perfection of the polarised relays. For this reason one of us has had some polarised relays constructed that are sensitive to $\frac{1}{2000}$th of an ampere. As the distance of the armature of the relay from its stop and consequently the duration of the stroke of the armature can be made extremely small, we can reduce the terms t_1, &c.

In the long lines of an ordinary telegraph system we must at each signal wait for the establishment of the permanent state in the line. In the case under consideration the line no longer exists, but is replaced by the induction coil. The latter possesses a time constant just as a long wire does, but the cause is different—it is self-induction, not capacity. The question is, therefore, to see how to reduce the term t.

We propose to return to this subject again shortly.

CORRESPONDENCE.

Electricity Supply in Small Towns.

I am obliged for your kindly criticism on my paper read before the Association of Municipal and County Engineers, but take exception to some of your comments.

The question of "horsing" tramways during the hours of lapping load is not my suggestion, but is one propounded by Mr. Robert Hammond, and is, I think, worthy of consideration, as people who live in small towns know that most of the jobmasters would be delighted to find occupation for their horses during the hours of darkness, and would be willing to negotiate with the tramway authorities for their use at a very small cost; the tramway authorities would have to provide no stables, food, or horses. Of course, I am aware that trailers, or cars without the motors, would have to be used; but this again resolves itself into the question as to whether in small country towns, where the visitors use the trams during the daytime, and *not* during the hours of darkness, whether a less frequent service would not be sufficient during these hours? Anyhow, I do not see the impracticability of such a proceeding, although I admit that only in certain cases and under certain conditions would it be profitable to do so. No great point of this method was made in my paper.

Then, again, you say that by the combination of tramways and lighting, "The gain is on the part of the lighting system, at the expense of traction." I do not agree with you here, and I think you will find that my opinion is backed up by all the well-known "unbiased" engineers. One of the special claims set forth in a company just launched, viz., the Electrical Power and Distribution Company, is that electricity can be supplied for *all* purposes at a much cheaper rate than it can be supplied for lighting only. The men who have sanctioned such a statement are Messrs. Garcke, J. S. Raworth, S. Hilton, W. L. Madgen, &c.

1. I would point out to you that the staff employed at the electricity works when tramways and lighting are combined is about half of what would have to be employed if the works were separate.

2. The handling of fuel, the cost of water, the cost of cleaning, &c., is much less when dealing with it on a large scale, than it would be if the works were separate, and (separate) arrangements had to be made for the handling of fuel and the use of water.

3. The nuisance caused by the establishment of works can be centralised, instead of being in two places. If you read my paper carefully, you will notice that the one proviso is that the works must be situated in a suitable spot for both purposes. Of course, if the lighting works are not situated in a suitable spot, then it does not comply with the conditions I lay down, and, under these circumstances, it may be better to have separate works. I should much like to hear your argument in justification of the point that "All the gain is on the part of the lighting system, at the *expense* of the traction."

With regard to the question of being literally correct, I admit that your criticism is right, but I was never one for "splitting straws," and I had not forgotten the fact that I was reading a paper before a body of engineers, who were accustomed to take the language not absolutely literally, but could quite understand what I meant when I stated that "There was no (apparent) energy in coal, until it was burning." This, of course, does not bear upon the practical value of the paper, and therefore I am not anxious to take up more space than is necessary in answering same.

Horace Boot,
Borough Electrical Engineer,

Tunbridge Wells,
November 7th, 1900.

[We cannot agree with Mr. Boot that the idea of "horsing" electric tramways, whether his own or Mr. Hammond's, is practicable. It is costly enough to maintain a stud of horses when they belong to the tramway undertakers; the delighted jobmasters would want a fair (?) profit on the use of their horses, and difficulties innumerable would arise between the parties as to terms, compensation for injuries, &c. Again, a large stock of horse cars would have to be kept; these would be sandwiched in between such motor cars as were retained in service, reducing the average speed of the cars to half its normal value. To maintain the ordinary service, therefore, would call for twice as many cars with drivers and conductors. The heaviest load on a tramway system comes between 4 and 7 p.m., just when the lighting load is heaviest—visitors notwithstanding—and at this time it would be handicapped by halving the speed.

As for the question of combination, so often discussed, we quite agree that on this system electricity can be supplied for *all* purposes at a much cheaper rate than it can be supplied *for lighting only*. But our point is that it will not thus be supplied *for traction* at as cheap a rate as it can be supplied *for traction only*. We have on previous occasions pointed out that the staff may be reduced by combining the two functions in one station, though we doubt whether it could

be cut down to half, and we have supported the combination in the case of small towns. The fact remains, however, that while the station load factor is improved as compared with that of a lighting station, it is not nearly so good as the traction load factor alone, and the reduction in staff is accomplished by placing the small day load of the lighting system in charge of men whose most important duty by far is to attend to the traction load. In fact, the staff of the traction system is not materially reduced; the gain is practically confined to the lighting service.

As regards the energy in coal, we have only to say that the word "apparent" did not appear in the original paper. —Eds. Elec. Rev.]

Combined Tenders.

It is with interest that I note your editorial on the above subject in the issue of October 26th, which I have only just seen, on account of my absence on the Continent.

I fully agree with you that the stand you take should be most beneficial to buyer as well as to seller. As a seller of dynamos, I am often hampered by having to furnish a complete plant, consisting of steam engine, piping in some cases, dynamos, &c., and, as you rightly state, the electrical part is comparatively small to the total, but still the electrician has to furnish something he does not make, simply because the public has been accustomed to inquire of the electrician for the complete plant.

As a matter of course, nobody would furnish machinery and take the responsibility of same without being paid for it; and if, therefore, the dynamo builder has to furnish the plant, he has to make a profit on the steam part, and *vice versâ*.

I have just been told that in Germany the electrical companies have agreed not to furnish a steam engine with a plant without adding 5 per cent. of profit to same. This is a very good idea, as not only does it put everybody on a fair basis, but it also gives the buyer the advantage of buying it himself without paying the additional 5 per cent.

From the buyer's standpoint, however, it may seem that he only wants to hold one man responsible in case of the plant not coming up to its requirements; but if he is dealing with responsible firms, there should be no difficulty whatsoever in settling the point as to who is to blame if anything is wrong.

I remember a case where a plant was erected consisting of a compound dynamo and a high-speed horizontal engine. When the motor load was put on all the lights went down, and when the load was taken off up went the lights. The engine builder insisted that the dynamo was not properly compounded, and the electrician claimed that the engine did not regulate properly. The dispute was, of course, easily settled, and the engine, which did not govern as guaranteed, was taken out and replaced with one that did.

I dare say that if a dispute should arise in a case where the engine and dynamo were furnished separately by different contractors the same could easily be settled by arbitration.

I repeat what I said in an article on this subject which I wrote some years ago for the *Electrical Review* in New York, viz., that I do not see why a dynamo builder should furnish steam engines any more than a coach builder should furnish horses.

Ch. Leven.

November 12th, 1900.

National Wiring Company v. Jones.

We beg to draw your attention to the report of our case against Jones, which appears in your paper for week ending the 9th inst.

Your reporter has apparently not taken down the proceedings accurately. Mr. Jenkinson, our late manager, is stated to have said that the best workmen were not employed, although they were capable. What Mr. Jenkinson did say was that the men employed were the best that could be obtained. Mr. R. J. Drake (should read Digby) is also stated to have said that there was great damage from fire. There never has been a fire, and the light has been constantly in use for over two years.

As such an erroneous report is likely to do our business harm, we shall be obliged if you will put matters right in your next issue.

The National Electric Wiring Company, Limited,
W. B. Cowing, *Manager and Secretary.*

Transformers for Cable Testing.

With reference to Messrs. Cowans' letter in your last issue, I must say that in making the somewhat sweeping statement referred to, I was unaware of the existence of the special design of regulating transformer described by them, but, from the description given in their letter, I should imagine that it is admirably suited to the requirements of high voltage testing, and I must congratulate Messrs. Cowans upon their enterprise in thus supplying a long-felt want by the introduction of a device which will, I trust, meet with the success it deserves.

J. Wright.

Continental Steam Engine Practice.

In view of your leading article in last week's issue, entitled "Continental Steam Engine Practice," I shall esteem it a favour if you will kindly allow me, in justice to the firm I have the honour of representing, to make a few remarks in reference to the statements made therein.

Our 1,000-H.P. "accelerated speed" engine, which was exhibited at the Paris Exhibition of this year, ran without the slightest mishap throughout the seven months during which this Exhibition was open; also on those days on which our engine was held in reserve whilst other engines were running, the management of the Exhibition electric supply *invariably* had recourse to our engine to take the place of others which were obliged to shut down through one fault or another. Doubtless your informant may have been unaware that the different engines exhibited had to take turn-about for the service, and the impression may have been given that those engines which were held in reserve were incapable of running, whereas this was by no means the case.

It may also be of interest for your readers to know that the high finish given on certain Belgian engines is not put on for exhibition purposes, nor is it confined to the external parts. The material, the workmanship and the design, are of the highest possible standard throughout. It will be a revelation to some unacquainted with Belgian steam engine practice to learn that of the thousands of engines supplied by my firm throughout Europe, not one of these engines has ever been erected at the works, and the first time that the parts are put together is on the site prepared for the engines to run definitely, and they are invariably ready for continuous running a few minutes after starting up.

Were your readers able to glance into the order books of the leading British iron and steel producers, they would discover that only the very highest grades were asked for by the leading Belgian engine builders, and also that enormous quantities of these grades were being continually shipped from this country to Belgium.

I also beg to state that, as municipal engineer to the Brussels municipality during a period of four years, I was able to get a complete insight into the working of six 600-H.P. condensing engines manufactured by the firm I now represent, and during the whole of that time we never had the slightest mishap to any one of the engines in question. It is on account of my experience with these engines under actual running conditions, that I was induced to undertake the interests of this firm in England.

J. Pullar Phibbs,
English Representative for Messrs.
Carels Frères, Ghent, Belgium.

E

Comparative Cost of 100 Volts and 200 Volts Supply.

Referring to a Note in last week's Review asking someone to publish actual figures relating to the charges to consumers, before and after increasing the pressure of supply, I have much pleasure in enclosing a list, as Tunbridge Wells was the first town giving an alternate current supply, to change over from the 110-volt to the 220-volt pressure on the networks (as early as December, 1895).

Horace Boot,
Borough Electrical Engineer.

Tunbridge Wells,
November 12th, 1900.

Consumers' No.	110-volt charges. March.	June.	September.	December.	220-volt charges. March.	June.	September.	December.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
2	7 16 0	2 14 4	3 4 3	9 1 9	5 4 8	1 12 0	1 8 4	4 19 9
4	13 4 0	4 15 4	6 2 4	15 13 10	14 6 11	4 6 9	5 6 3	14 9 9
6	12 5 9	3 17 0	4 3 8	9 16 4	8 15 10	3 4 0	2 19 7	3 11 6
11	3 16 5	3 9 7	2 15 10	3 14 8	3 10 9	2 5 0	2 16 1	5 19 6
12	7 5 9	5 0 1	3 19 4	6 4 4	9 10 9	0 14 0	3 6 0	6 9 9
37	11 18 6	6 7 4	6 15 4	11 17 7	9 14 10	2 12 3	5 13 3	10 10 6
39	3 15 2	1 15 6	2 1 11	3 8 5	3 12 3	1 15 6	1 18 0	2 4 0
57	5 19 1	2 7 5	2 17 7	5 15 0	4 19 10	2 5 6	2 1 6	4 2 6
62	2 11 5	1 1 1	0 16 8	2 6 2	4 2 6	0 12 6	0 19 6	0 17 6
63	4 12 7	2 12 4	3 1 6	4 10 2	4 8 8	1 12 0	2 14 2	3 12 0
64	1 15 0	0 12 6	0 13 0	2 10 0	2 13 10	0 12 6	0 12 6	1 5 0
65	13 17 2	5 3 10	3 15 6	15 6 3	10 0 7	2 18 0	3 12 1	10 1 9
67	9 7 1	2 18 5	3 4 8	9 0 0	11 4 1	3 2 6	5 9 3	7 18 0
71	2 18 2	0 15 0	2 11 0	4 0 0	4 14 4	1 15 6	1 18 9	4 14 6
72	10 7 7	6 0 11	5 16 10	11 4 7	12 19 4	6 0 6	4 5 10	9 9 6
73	3 10 10	2 13 1	3 1 8	3 13 3	2 16 11	2 1 0	3 11 3	4 13 9
74	9 11 7	5 18 3	1 7 0	9 11 6	12 0 0	3 14 3	4 4 10	9 4 6
77	4 9 5	0 15 10	0 14 6	4 3 5	4 7 5	0 15 6	0 16 0	5 7 6
82	5 6 4	2 2 2	2 5 6	3 6 8	4 13 0	2 0 0	1 17 5	2 1 6
85	4 13 0	2 14 0	1 17 2	5 0 11	4 15 9	2 11 0	2 6 1	5 15 6
88	6 16 5	3 3 7	2 15 0	5 15 2	5 9 10	2 1 9	2 11 6	4 12 6
93	23 11 4	11 7 6	10 13 4	16 14 8	14 19 10	10 3 9	10 6 0	26 16 6
95	3 1 2	0 12 6	1 6 11	1 10 2	3 14 9	1 13 0	1 14 1	4 6 6
98	5 14 6	1 18 7	4 7 7	3 8 1	7 4 2	1 15 0	2 12 0	4 5 6
101	2 7 10	0 12 6	0 12 6	1 19 0	1 17 7	0 12 6	0 12 6	2 12 0
102	8 12 2	3 7 0	4 3 1	8 19 10	8 15 7	3 7 0	3 11 1	8 6 3
104	5 1 6	2 18 4	1 14 8	3 15 6	2 15 4	2 17 6	1 11 8	2 5 3
106	15 15 6	6 8 7	7 4 6	17 3 10	16 6 6	7 7 0	7 5 11	9 6 0
107	35 6 5	17 5 11	13 14 4	31 3 9	23 19 0	8 14 0	8 14 0	11 4 6
109	1 9 1	1 3 11	0 17 6	1 3 2	1 13 6	2 0 0	1 10 1	1 19 0
110	5 4 3	1 9 2	1 14 7	3 11 1	3 11 7	1 19 0	2 9 10	3 8 0
111	6 1 7	0 15 0	0 17 5	5 12 7	5 4 8	0 14 0	0 17 2	3 13 6
112	5 6 10	2 1 4	2 16 10	5 2 1	4 14 9	2 11 0	2 16 0	2 12 3
114	6 4 0	1 18 5	1 17 10	3 15 5	3 1 3	1 11 6	0 15 0	2 0 3
116	2 9 4	0 17 1	1 0 6	2 9 10	2 10 7	0 16 3	1 6 0	1 18 3

Number of Units Consumed.

Consumers' No.	110 volts. March.	June.	Sept.	Dec.	220 volts. March.	June.	Sept.	Dec.
2	307	104	124	370	204	59	52	241
4	523	185	239	701	549	216	250	698
6	501	144	157	384	343	120	111	146
11	132	119	91	137	129	78	100	226
12	281	190	148	240	373	37	123	302
37	467	244	260	480	381	193	219	756
39	145	65	78	141	139	66	71	148
57	233	89	110	225	194	86	78	260
62	97	37	28	87	160	17	34	30
63	180	99	118	215	184	59	126	274
64	65	6	11	10	102	16	17	45
65	539	192	135	602	391	106	134	622
67	369	111	124	388	480	224	210	506
71	106	20	92	155	183	76	72	184
72	405	231	223	441	510	233	163	545
73	131	96	113	134	101	70	130	216
74	378	231	44	374	471	203	161	608
77	173	26	24	161	169	26	27	242
82	202	74	81	125	177	72	66	86
85	171	93	59	191	181	92	82	221
88	267	122	105	234	214	107	98	308
93	927	440	411	657	587	396	400	1,061
95	117	14	48	55	144	61	63	249
98	224	72	170	131	321	130	99	291
101	90	7	9	73	70	5	16	98
104	193	106	59	143	102	106	55	113
106	621	247	278	691	645	286	283	662
107	1,397	676	533	1,412	1,200	340	340	682
109	47	37	25	38	58	72	52	69
110	203	53	64	134	136	73	94	227
111	233	14	24	217	201	19	26	264
112	208	77	108	199	184	97	107	185
114	243	71	70	145	117	58	25	111
116	93	29	36	101	96	31	47	110

Water-Tube Boilers.

We notice in your issue of 9th inst., under the heading "The Coal-Eating Water-Tube Boiler," an extract from the *Pall Mall Gazette* of 6th inst., in which statements are made reflecting very unfavourably on the performance of the four Babcock & Wilcox patent water-tube marine boilers with which the steamship *Martello* has recently been fitted.

As the statements are totally incorrect, and if allowed to pass unchallenged, calculated to create a very wrong impression as to the advantages of our type of water-tube marine boiler, we trust that you will publish a letter on the subject from the owners of the vessel, Messrs. Thos. Wilson, Sons & Co., Limited, which also appeared in the *Pall Mall Gazette* of 8th inst., and of which a copy is hereto attached.

Babcock & Wilcox, Limited.

November 12th, 1900.

[copy.]

Extract from the *Pall Mall Gazette*.

Extra Special Edition, November 8th, 1900.

Sir,—We notice a paragraph in your issue of the 6th inst., referring to our ss. *Martello*, in which you state that this vessel burnt 448 tons more coal on her voyage since being fitted with water-tube boilers than she did previously with ordinary cylindrical boilers.

This is quite incorrect, the coal consumption on her first voyage with water-tube boilers being 100 tons less than the average of three years with ordinary boilers, and the speed is 1·72 knots faster.

We think, in courtesy to us, you should have given us the opportunity of verifying your figures before publishing them, which we shall at all times be pleased to do, and we should be much obliged by your letting us know how you got this most inaccurate information. The ship is now on her second voyage, and we have every reason to believe that the performance will be improved.

We may add that nine of our steamers are fitted with Messrs.

Babcock & Wilcox's water-tube boilers. We had one ship fitted with Belleville boilers, but our experience was so disastrous that they were replaced by the ordinary boilers.

For Thos. Wilson, Sons & Co., Limited,
(s) Charles H. Wilson, M.P., *Chairman.*

The Editor, *Pall Mall Gazette.*

[We have great pleasure in inserting these letters. There was no indication in the note that the Babcock boiler was referred to. Our last issue had just gone to press when the extra special of the *Pall Mall* appeared, so that it was impossible to print it along with the original paragraph.—Eds. Elec. Rev.]

Fetish Worship.

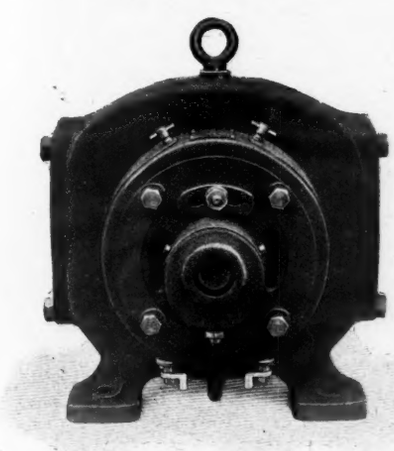
How very apposite was Prof. Perry's linking of England and China in his presidential address to the I.E.E.; for is it not true that on the one side the Chinese object to the introduction of railways in their neighbourhood as likely to disturb the ancestral spirits, and so disturb their free worship of the same, and on the other, certain professors object to the introduction of electrical tramways in their neighbourhood as likely to interfere with their worship of magnetic records!

F. J.

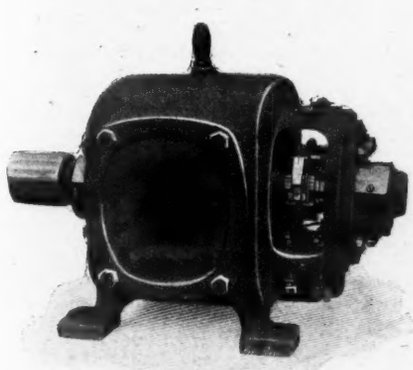
November 12th, 1900.

ENCLOSED ELECTRIC MOTORS.

The illustrations which we give herewith show the appearance and construction of the "Bull" motor, which is being manufactured by the Anglian Engineering Company, Limited, of Stowmarket. It is



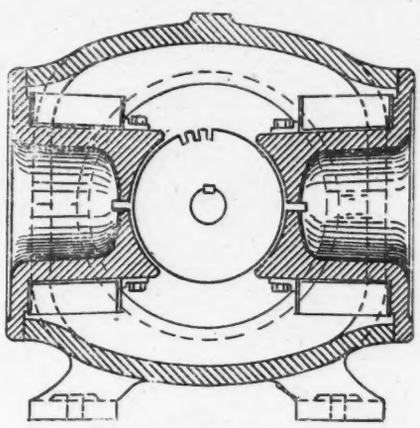
End View, Covers in Place.



Side View, Brushes Exposed.

claimed that the design of this motor embodies many features of great value; every part is readily accessible—the armature can be withdrawn from either end, the field magnets can be removed without disturbing other parts of the machine, and large covered hand-holes afford easy access to the brush gear.

The general type of construction is shown by the cross-sectional view. The armature is of the usual form, drum wound. The field magnet core is hollow, so as to afford a larger cooling surface, and in the ventilated type a slot is cut in the pole face, as shown, to admit cool air to the armature surface, besides reducing distortion of the field. The brush-holders are arranged for radial carbon brushes, with a long and uniform spring feed, and the brushes can readily be renewed when necessary. An unusual feature is the fact that the frame is cast in one piece; almost all the machining on it can be done in a lathe, reducing the cost to a minimum. The large cooling surface enables the temperature rise to be kept down, and the motor is said to run continuously with an overload of 25 per cent., or for a short time, of 50 per cent., without injury; sparking is also absent from no load up to 25 per cent. overload, and the



Cross-Section of Motor.

brushes do not require shifting. Means are provided, however, for shifting the brushes from the outside, in order to vary the speed over a range of 10 to 15 per cent.; this also entails no sparking. Particular attention has been accorded to the automatic lubrication of the bearings, to enable the motor to run for long periods without attention.

Special labour-saving machinery has been installed for the manufacture of the parts of the motor to stock sizes; low speeds and low prices are aimed at, and the machines are wound series, shunt or compound as desired.

Dynamos of a type similar to that of these motors are also made by the company, either two-pole or multipolar; and electric pumping plants are a special feature of their business.

OUR LEGAL QUERY COLUMN.

Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

No. 30.

"Perplexed" writes:—"Will you be good enough to inform me whether the local authority have any power to repay money paid to them under the following circumstances:—The occupiers of a house have for the last three years paid an electric lighting rent estimated according to the register of their meter. It now transpires that the meter has, for some considerable time, been 'lying like a gas meter,' and that the unfortunate occupiers have been paying to the undertakers a sum largely in excess of that to which the latter are lawfully entitled. Can the undertakers be compelled to repay all or any part of the meter rent charged in excess? Please quote authority. Of course, the rate has been demanded, and would it make a difference that the amount was paid under the impression that the occupiers were legally liable."

*** We are not aware of any case exactly on all fours with that put by our correspondent. The register of a *gas meter* is *primâ facie* evidence of the quantity consumed, and two justices may settle the difference (Gas Light and Coke Company *v.* Cresswell, 97, 1 J.P., 699). An important difference is made with regard to an electric lighting meter, the register of which affords conclusive evidence. Thus Clause 54 of the Electric Lighting (Clauses) Act of 1899, after declaring that in case of dispute the electric inspector must decide whether the meter is or is not in proper order, provides that the register of the meter shall be conclusive evidence of the value of the supply; but it is important to notice that the accuracy of a meter which was sworn to be perfectly correct by a Government inspector, was successfully disputed at Wandsworth Police Court, July, 1887 (see Wandsworth and Putney Gas Company *v.* Rye, 31 Sol J., 633).

We may add that nine of our steamers are fitted with Messrs.

Another fact which appears to militate against our correspondent's chance of success is this—money paid under mistake cannot be recovered. In the old case of Marriott *v.* Hampton, the plaintiff, who had lost a receipt, paid the defendant twice over in respect of the same transaction. He sought to recover the amount paid under mistake, but it was decided that he could not do so.

We read of a similar case in connection with a water rate. The defendants, who were the sanitary authority at Burnley, had demanded from the plaintiff, and the plaintiff had paid a water rate of £8 15s. 4d., such rate being calculated on the "gross rental" of his premises. The plaintiff, contending that such rate ought to have been assessed on the "rateable value" only, brought an action in the County Court to recover the difference overpaid. The defendants had no power to distrain for rates, but they had power to stop the water supply for non-payment; they had not stopped it, nor had they threatened to do so. It was decided in a Divisional Court that the payment was a voluntary one, and could not be recovered (Slater *v.* Burnley 59 L.T. 636; 36 W.R. 831). If not conclusive upon the point under discussion, this case is strongly opposed to the interests of our correspondent.

No. 31.

"Woodstock" writes:—"Could you please answer me the following in this week's Review:—The Parish Council are desirous of lighting the town by electricity. How can the present authorities obtain the power? Only part of the parish is in the lighting area. The clerk says we are to get urban powers. Is this so? The gas is a monopoly, and is very unsatisfactory. Please let me know at once, as we want to take immediate steps."

*** With all respects to "Woodstock," his somewhat meagre statement of fact renders it difficult to formulate a very definite or very satisfactory reply to his query.

Assuming, however, that the Parish Council wish to have powers to light their own parish, it would appear that they must proceed in the manner prescribed by the rules which have been enacted by the Board of Trade (see Board of Trade Rules, 1890). For us to prescribe the proper application of those Rules, we should be informed (*a*) whether there is any local authority, company, or person authorised to supply electricity in the parish or any part thereof; (*b*) whether there are other local authorities having control over any part of the parish; and any other facts. If "Woodstock" will throw some further light on these points, we shall endeavour to answer him more fully next week.

[N.B.—We would take this opportunity of observing that although it is expedient that queries should be concise, they should be so drawn as to give our legal correspondent enough information to enable him to give a satisfactory answer].

LEGAL.

The Attorney-General *v.* The National Telephone Company, Limited.

The action of the Attorney-General *v.* The National Telephone Company, Limited, which concerns the rights of the latter to break up the streets in the jurisdiction of the London County Council, was down for hearing before Mr. Justice Wills and a special jury on Monday. Mr. Dickens, Q.C., and Mr. Daldy, were counsel for the Crown, and Sir Edward Clarke, Q.C., Mr. Joseph Walton, Q.C., and Mr. Roskill, for the defendant company.

Mr. Daldy, in opening the pleadings, said the Attorney-General, on the relation of the London County Council, was the plaintiff, and the National Telephone Company, the defendants. The action was brought to restrain the defendant company from breaking up the streets within the jurisdiction of the London County Council for the purpose of laying down telephone wires without their consent. The action was brought on two grounds—first, that under the Telegraph Acts they had no right to do what they had done; and, secondly, that they were creating an obstruction by breaking up the streets. The defendants said they were not acting under the Telegraph Acts at all, and that what they had done was no obstruction.

Sir Edward Clarke said a short correspondence had taken place between the solicitors to the parties to which, in the interest of the public time, he ought to call attention. This was one of two sets of proceedings brought against the National Telephone Company—one by the Postmaster-General in the interests of the public, and the other by the Attorney-General on the relation of the London County Council. They both substantially involved the same question, namely, whether an injunction should be granted, and they both involved very serious questions of law as well as complicated questions of fact. The information of the Crown came on first, and was before the Courts some time ago, and the telephone company submitted to terms under which they were restrained from doing any work for the purpose of extending the existing system of the company under the streets of London, and the whole object that could be achieved by success in the litigation now before his Lordship had been completely fulfilled in the terms arrived at in the other action; and under the circumstances his clients had written an open letter to be used in Court, and to the defendants' solicitors, which he would read. Counsel then read the letter, which suggested that it would be worth while considering the position as between the parties. The result of the previous action, which was to restrain the defendants from breaking the surface of any streets within the jurisdiction of the County Council for the purposes of laying underground wires without obtaining the authority of the Postmaster-General, carried all that the County Council could require, and it was suggested that it would be a useless waste of money to go on with the present action at present. The reply to the letter stated that the plaintiffs' solicitors would, if a similar judgment to that given the former case was consented to, be prepared to put an end to the present proceedings. He (Sir Edward Clarke) said he could not consent to that, but there would be litigation which could not in any case stop there, but would be taken before another Court. He submitted, however, that it would be a waste of public time to go on at present, seeing that what was asked for had been secured by another action.

Mr. Dickens agreed that it would not be advisable to enter into any long litigation at present, but his difficulty was that he had not had an opportunity of seeing the members of the Highways Committee, and he should like to do so before consenting to any arrangement.

Mr. Justice Wills said he did not at the present moment quite appreciate the difficulty of the defendants giving the same undertaking as they had given to the Postmaster-General. It was not likely the Postmaster-General would allow them to break up the streets without they obtained the sanction of the County Council.

Sir Edward Clarke said he could not consent to come under the terms of any injunction yet, as there were important legal questions which he should want to raise. He suggested that the action should stand over generally with leave to apply to restore it.

Mr. Justice Wills said that perhaps the defendant company would give an undertaking not to do anything in contravention of the order obtained by the Postmaster-General without giving due notice of it.

Sir Edward Clarke said his clients were quite prepared to undertake that no action should be taken of that kind if the matter stood over generally.

Ultimately it was agreed to allow the action to stand over for a fortnight, counsel arranging to consult their clients in the meantime. After that they could, if necessary, go on with it.

The Recording Telegraphs, Limited.

In the Companies' Winding-up Court on Wednesday, before Mr. Justice Wright, the petition of Messrs. Segrue & Co., Limited, for the compulsory winding-up the Recording Telegraphs, Limited, was again down for hearing.

Mr. Jenkins, Q.C., said the petition was by a creditor. At the time the petition was presented a voluntary winding-up was contemplated, and pending the hearing of the petition it was resolved upon. His clients were now in another position, and he had not now any materials on which to ask for a compulsory order, notwithstanding the voluntarily winding-up, although they might like one. His friend, Mr. Neville, who appeared for other petitioners, said on the last occasion he could get materials, and as soon as he did so he would supply them to his (Mr. Jenkins) clients. They had not yet, however, received such evidence, and he, therefore, asked for a further adjournment.

Mr. Neville said, on behalf of a number of creditors, he asked for a compulsory order as against a supervision order. He asked for an adjournment, in order that copies of his evidence might be supplied to Mr. Jenkins, and also to the company.

His Lorship adjourned the further hearing of the petition for a week.

BUSINESS NOTES.

Auction Sales.—Full particulars are given in our advertisements this week of the freehold land and works and electric light and power plant at Oldbury, which Messrs. Wheatley Kirk, Price & Co. will offer for sale on December 5th.

Bankruptcy Proceedings.—Mr. C. Bennett Harness, whose name will not be unfamiliar to our readers, appeared on 8th inst. before the Registrar, at the Wandsworth County Court, for the purpose of undergoing his public examination in bankruptcy. The receiving order was made in October last, and the total liabilities were stated by the debtor to be about £7,500. The assets were *nil*. The debtor attributed his insolvency to liability incurred in respect of a guarantee given in connection with the reconstruction of the Medical Battery Company, Limited, and to law costs. Examined by the Official Receiver, the debtor said that from 1881 to 1893 he was managing director of the Medical Battery Company, Limited, at a salary of £2,000 per annum. For years past his wife had paid household expenses out of her private means. He originated the Medical Battery Company 20 years ago, and a year later it became a limited liability company. Debtor, his wife, and a few family friends held shares. There was no public allotment. The business was carried on most successfully until November, 1892, and from 1890 to 1892 a profit of £15,000 to £16,000 was made out. The profits were put back into the company during the prosperous years. He retained about £1,000 for personal expenses. Litigation had entirely ruined his business. The examination was adjourned till the 22nd inst.

Electrical Wares Exported.

Week ending Nov. 14th, 1899.		Week ending Nov. 13th, 1900.	
Alexandria	Value £756	Amsterdam	Value £155
Amsterdam	901	Barcelona	25
Antwerp. Elec. fuses	302	Bombay	181
Bangkok. Teleg. mat.	95	,, Teleg. mat.	121
Bergen. Teleg. cable	10,675	Calcutta	1,267
Boulogne	65	Cape Town	83
Brisbane	133	Channel Islands	280
Buenos Ayres. Teleg. mat.	50	Christiania. Teleg. wire	55
Calcutta	146	Colombo	341
Cape Town	468	Copenhagen. Teleg. wire	125
Christchurch	17	Durban	945
Christiania. Teleg. wire	68	Emden. Teleg. mat.	57
Colombo	85	Gothenburg	23
Durban	95	Halifax. Teleg. cable	6,000
Gibraltar	20	Hiogo. Teleg. cable	770
Gothenburg. Teleg. wire	12	Launceston	441
Hamburg. Teleg. mat.	440	Madras	26
Hong Kong	58	Melbourne	1,737
Kobe. Teleg. cable	145	Montreal	200
Launceston. Elec. motor	118	Monte Video. Teleg. mat.	165,728
Lyttleton	24	Ostend	170
Madeira	18	Otago	57
Marseilles	69	Penang	47
Melbourne	133	Riga	956
,, Teleg. wire	974	Rio Janeiro	175
Monte Video	100	,, Teleg. mat.	7,157
Ostend	221	Santos. Teleg. mat., &c.	35
Perth	534	Shanghai	150
Piraeus	16	Singapore	306
Port Elizabeth	279	Stockholm. Teleg. mat.	401
Port Said	23	Sydney	1,849
Santander	108	,, Teleg. mat.	360
St. Petersburg. Teleg. mat.	38	Wellington	312
Shanghai	12	,, Teleph. mat.	200
Stockholm. Teleg. mat.	143	Yokohama	185
Sydney	186	,, Elec. dynamos	2,850
Wellington	448	,, Teleg. cable	7,586
,, Teleph. mat.	360		
Yokohama	1,096		
,, Teleg. mat.	244		
,, Telephones	360		
Total	£30,464	Total	£199,801

Foreign Goods Transhipped.

Adelaide. Teleph. mat.	Value £111	Bangkok. Elec. lamps	Value £173
Cape Town. Telephones	113	St. Petersburg. Elec. light fittings	11
Total	£224	Total	£184

Books Received.—"Manual of Electrical Undertakings," by P. Garcke. London: Donington House, W.C.

"The Theory of Commutation," by C. C. Hawkins, M.A., M.I.E.E. London: George Tucker. 2s. 6d.

"La Théorie des Ions et l'Electrolyse," by A. Hollard. Paris: G. Carré and C. Naud. 1900. 5 francs.

"The Process Year Book for 1900," edited by W. Gamble. London: Penrose & Co.

"Report of the Board of Education," 1899-1900, Vols. I., II. and III. London: Eyre & Spottiswoode. 6d., 1s. 3d., and 3s. 6d. respectively.

Catalogues and Lists.—A pocket folding circular of the Langdon-Davies single-phase alternate current motors has been issued, in which are given prices and speeds of standard and special low speed pattern motors.

A supplementary list of electrical supplies has been published by Messrs. A. Vandam & Co., giving details of new goods introduced since the issue of their catalogue in October 1898. These include the "Dania" dry cells, and a variety of ceiling roses, cut-outs, switches, and wall plugs. The "Victoria" dwarf enclosed arc lamps, which are made in two types, one for operating singly without transformer on alternating current circuits, and the other for direct current, are also described.

Messrs. Neville Bros., of Liverpool, in their September, 1900 list, give details and illustrations of a number of electricians' tools which they are supplying. These include Mann's slot-clearing machine, automatic feed coil winding machines, electric drive ditto, the "Stoll" armature disc, segment, and ring automatic notching and dividing machines, the "New Jersey" ditto, automatic tissue papering machine for papering sheet iron for armature discs or ready cut-out discs, dynamo makers' presses, and other tools of the same character for dynamo, motor, and other electrical work.

The Bruun-Lowener patent water-softening apparatus forms the subject of a well-printed and illustrated list which is sent to us by Mr. Valdemar Hansen, of Great Tower Street, E.C., who is the sole agent for the United Kingdom. It is claimed for this softener that it is absolutely reliable, is perfectly automatic in its working, simple in its construction, is easily attended to, and is cheap both in first cost and in working expenses. Ordinary chemicals, mixed with the water, precipitate the hard substance, no secret compounds being used. The Bruun-Lowener softener is made in five different types to meet varied requirements, and in the list to which we have referred, these are described and notes of dimensions and capacities are given. Testimonials emanating from users are printed, and are followed by some pages of statistics of the various plants, and their capacities, which have been supplied to a score or two of works, factories, &c., in England and to great numbers of Continental engineering works, gas works, breweries and so forth.

The International Pneumatic Tool Company, Limited, of Palace Chambers, S.W., and Chippenham, have brought out a catalogue of their portable pneumatic tools, for which are claimed economy in the use of air, lightness of weight and simplicity of construction. The tools described therein are "Little Giant" piston air drills; breast and screw feed drills with compound gear, allowing high speed for small drilling and low speed for large drilling; pneumatic hammers especially adapted for chipping, calking and beading flues, reversible double spindle boring machines, reversible flue rolling machines, pneumatic motor chain hoists, pneumatic blow off cocks, and a variety of parts and fittings for the various tools. There are numerous illustrations of the machines, some showing them at work.

The British Westinghouse Electric and Manufacturing Company, Limited, have issued their circular No. 1,035, which describes the Westinghouse 12A tramway motor.

A pamphlet describing their new water-level apparatus, intended for asylums, hospitals, and large institutions, has been brought out by Messrs. Gent & Co., of Leicester. By means of this indicator engineers or superintendents may see without leaving their offices the exact quantity of water in a reservoir, whether the pumping is done regularly, and also obtain automatic weekly or daily diagrams showing the exact depth of water at any moment. The installation consists of a transmitter at the reservoir, a receiver indicator, or recorder in the office or engine room, with a battery and the necessary wiring connections. The list before us gives a brief description of the apparatus and explains the fixing.

Two circulars are to hand from Mr. James Dickson, of Gray's Inn Road, describing the "Ideal" incandescent lamp guard, and the "Tieciton" dynamo brush.

A list of the Wagner Electric Manufacturing Company, of St. Louis, U.S.A., gives details of their type "K" ammeter and type "F" wattmeter.

The "Hatfield" pump is manufactured solely by Messrs. Merryweather & Sons, Limited, of Long Acre, who own the patent. The company's water supply department has issued a good pamphlet giving particulars of the pump, which derives its title from Hatfield House, the residence of the Marquis of Salisbury, where the pump, driven by an electric motor, is used for domestic water and fire protection purposes. Illustrations given in the list before us show the pump driven by electric motors, also gas and oil engines, and there are many effective sketches relating to its application in water-power lighting plants, mining, and other work. A reprint is given of a brief extract from a paper read before the Institution of Mining Engineers, in June of this year, by Mr. Emerson Bainbridge, M.P., M.I.M.E., describing the chief features of the "Hatfield" pump for underground service.

The Doe Portable Electric Light and Power Syndicate, Limited, of Cannon Street, E.C., send us one of their general battery lists, in which extracts are given from reports upon the battery prepared by the late Dr. Hopkinson, Mr. Parshall, and Profs. Houston and Kennelly.

The B.T.H. Co.'s pamphlet No. 77 contains a description of their magnetic blow-out automatic circuit breakers. No. 78 deals with horizontal edgewise instruments.

Directory.—A new directory has been issued by Messrs. Hazell, Watson & Viney, Limited, of London (6s.). It is entitled "Directory and Statistics of Electric Lighting and Traction Works," in operation or projected in Great Britain and Ireland. The editor of the work is Mr. C. S. Vesey Brown, A.M.I.C.E., the Lincoln Corporation electrical engineer. The book is presumably to be issued as an annual, the present edition being for 1900—1901. It is divided into several sections:—I. Electric Lighting; II. Electric Traction; III. Light Railways; and there are others dealing with applications for powers, lists of officials, and so on. The principal features of the existing works are briefly given, and altogether there is much useful statistical information contained in the book.

East African Rubber.—Mr. Vice-Consul Marsden's report to the Foreign Office on the trade of the East African Protectorate, contains the following comments on rubber:—"Rubber shows an advance of 40 per cent. on the previous year, but is still far below what it should be, and what the country is capable of producing. This is due in a large measure to this industry being left to take care of itself, and no properly disciplined or organised effort made to assist it. In times of drought and bad harvests the natives fall back on the rubber-collecting harvest to keep themselves from starvation, but in times of plenty the industry is more or less neglected, and only vines which grow in those places easiest of approach are tapped, and in many cases ruined by being cut to the ground instead of tapped. I can only refer to the remarks made last year on this subject, and which I again repeat, with, if possible, greater emphasis, under the conviction that there is money for the private individual and for Government if the industry were more systematically worked."

Exhibition Souvenir.—We have received from Messrs Witting Bros., Limited, a handsome souvenir of the Paris Exhibition in the form of an album of photographs of the Exhibition buildings and of Messrs. Witting's exhibits therein. Most of the former, it need hardly be said, are very beautiful, while the latter are technically more interesting. No letterpress is appended to the photographs, so that we cannot enter into particulars; suffice it to say, that the number and variety of the exhibits, including electric railways, induction motors, large direct coupled alternators, &c., are well shown by the views which are comprised in this collection.

Foreign Electrical Plant.—There was an unusually large quantity of foreign electrical goods and apparatus imported into this country during October last, the total for the month being returned at £174,524, as compared with £97,107 in September, and £148,317 in August last. The aggregate imports for the ten months ending with October last are returned at a value of £969,923, or close on a million sterling.

Liquidations and Dissolutions.—The Coventry Gas Fittings, Electrical, and Engineering Company met at Birmingham on 12th inst. and passed resolutions in favour of a reconstruction of the company, and it was decided that it be wound up voluntarily, with Mr. T. M. Daffern as liquidator, a new company to be formed,

to be called the New Coventry Gas Fittings and Electrical Engineering Company. A committee of shareholders was appointed to assist the directors in carrying out the reconstruction scheme.

Messrs. R. F. Read and A. A. Jenkins (Read & Jenkins, electrical and mechanical engineers, Bristol) have dissolved partnership. Mr. Jenkins will attend to debts.

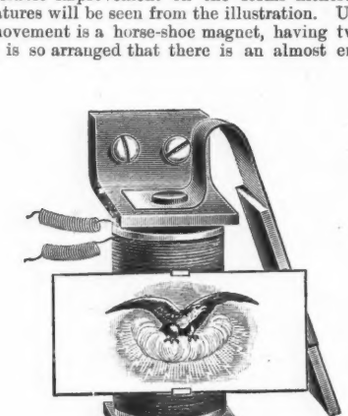
Notice is given of release of trustee (Mr. G. S. Barnes, Carey Street), in *re* Chitty Dynamo and Motor Company, Limited, of Willesden.

London County Council.—The Council at the meeting on Tuesday resolved to grant a loan of £1,142 to the Hampstead Guardians for the installation of the electric light at the workhouse.

The report of the Parliamentary Committee contained a reminder that the Council had decided to apply in the next session for general powers for doubling single lines of tramways with the consent of the Board of Trade. In this connection it had been suggested to the committee that general powers should also be sought to enable the Council to construct passing places in conjunction with the existing lines of tramways, short junctions between tramways with a view to affording facilities for through traffic, and small cross-over lines where required. It appeared desirable in the public interest that the Council should have powers to carry out small works of that kind without having to obtain Parliamentary powers in each case, and on the recommendation of the committee it was resolved to authorise them to apply for general powers on the above-mentioned basis.

It was decided to approve plans submitted on behalf of the Telegraph Construction and Maintenance Company, for the erection of a building to be used for the manufacture of cables at Enderby's wharf, River side, East Greenwich.

New Indicator Movement.—Messrs. Julius Sax & Co. are just introducing a new self-replacing pendulum indicator which is a considerable improvement on the forms hitherto in use. Its peculiar features will be seen from the illustration. Unlike the old type, the movement is a horse-shoe magnet, having two poles, and the spring is so arranged that there is an almost entirely closed



magnetic circuit. The force of attraction is, therefore, so great that the movement will swing for as much as two minutes. The effect of the current is first to close the circuit of the movement, and then that of the bell, so that less battery power is needed, and there is a more decided ring, the arrangement acting as a sort of relay. Every part of the indicator is made in Messrs. Julius Sax's own works, and the cabinet work is both substantial and well finished.

New Works.—We understand that Messrs. Rosling, Appleby & Fynn, Limited, of Bradford, are shortly to commence building operations for their proposed large electrical engineering works to be erected at Thornbury. At these works, which will be used for the manufacture of dynamos, motors, &c., the tools and equipment generally are to be on the most modern principles.

Partnership.—We are informed that Mr. A. H. Gibbings, M.I.E.E., and Mr. C. A. Baker, M.I.E.E., have entered into partnership as consulting engineers, and that the name of the firm will now be Messrs. Gibbings & Baker. Mr. Gibbings's successful career at Bradford is familiar to our readers; Mr. Baker has recently returned from Russia, where he has been responsible for the carrying out of a large contract in St. Petersburg, having prepared all the plans and specifications for an electric light and power station of 10,000 H.P., as well as advising generally on all points connected with the electrical equipment of the undertaking.

Refuse Destructor.—A refuse destructor on the Horsfall system has just been put in operation as the last function of the Strand District Board of Works, a body which is now absorbed in the City of Westminster. The destructor is situated at Shot Tower Wharf, on the south side of the river near Waterloo Bridge. It consists of six cells or furnaces, each having a grate area of 42 square feet. The rubbish or refuse is brought in by carts upon a high-level platform, and is from there tipped directly into the destructor, the carts being fitted with a rack and pinion for the purpose. In this way no handling of the refuse is needed. The six cells are placed back to back, three in each of the two rows. The furnaces are below the tipping deck or charging floor, but extending above the floor is a feeding chamber which is common to both rows of cells, and which thus divides the tipping deck into two parts. From this chamber the refuse falls to the furnaces. In the Strand installation little effort has been made to utilise the waste heat from the burning refuse. There is, however, a water-tube boiler placed between the cells and the dust chamber. This will supply steam for the forced draught, for the electric lighting of the works, and for working the mills which are to be erected for crushing clinker for mortar, concrete, paving slabs, &c.

The Horsfall Destructor Company, Limited, writes to the *Times* stating that the plant was designed to treat 12 tons of refuse per cell per day. The whole plant is intended to deal with 80 tons of refuse in 24 hours.

Trade Announcements.— Owing to increased business Messrs. A. Vandam & Co. have been obliged to move into larger premises. They have secured a new and convenient warehouse of six floors at 15, Gerrard Street, Soho, W., where they will be enabled to carry larger stocks.

The United Alkali Company, Limited, of Liverpool, have erected a plant at their Sullivan Works, Widnes, for the manufacture of carbide of calcium, which is with them a new industry, and they are now open to supply the market. The Carbide Department is under the management of Mr. Joseph Bastick, electrical engineer.

ELECTRIC LIGHT AND POWER NOTES.

Accrington.—The T.C. is applying for powers to borrow £1,511 for electric lighting purposes.

Alfreton.—Notice of the application of the U.D.C. for a provisional order is filed in the *London Gazette*.

Barmouth.—At a special meeting of the D.C. Mr. Abraham reported that he was negotiating with a strong company in England with a view of leasing the Council's right to supply the town with electricity.

Bridgend (Glam.).—The U.D.C. has for a long time being trying to transfer its prov. order to a company, without success. The B. of T. has now intimated that presuming the transfer will not be proceeded with, it proposes to revoke the order forthwith. Further communications are to be opened with the Board.

Brighton.—At the T.C. meeting on Friday the Lighting Committee reported that the borough engineer had recommended that 107 arc lights should be placed along the tramway routes. These would displace 150 incandescent electric lamps and 48 gas lamps. The cost of maintaining 107 arcs, estimated at £20 13s. 2d. each, would be £2,210, as compared with £825 for incandescent electric and gas lamps, an increased cost of £1,385. The capital cost of the arc lamps, approximately £60 each, would be £6,450, of which, at £35 each, £3,745 would be chargeable to the surveyor's department for posts and labour of erection, leaving £2,655 as the cost of the electrical apparatus. The cost of the posts might be considerably lessened if it were thought advisable to utilise the tramway posts in conjunction with the arc lamps where possible. The T.C. adopted the Committee's recommendation, and resolved that application should be made to the Local Government Board for sanction to the borrowing by the Council of £6,440 for a period of 15 years for the purpose of street lighting. The resident engineer reported as to the advisability of making a special tariff for the supply of electricity to churches, that he had carefully considered the question, and feared that if the Committee gave way in this respect and allowed churches an all-round special rate, they would break down the principle of charging by maximum demand, which had proved itself in the past to be the only satisfactory all-round method of charging, and establish a precedent which would surely lead to no end of trouble from other classes of consumers who would think, and not without reason, that they were equally entitled to consideration for special terms to meet their individual cases. If churches held meetings and used light on week nights they could not, in fairness, expect any better terms than any other class of consumer. It was different, however, if they used more light on Sundays than week nights, which was most probable, as they were then in a position to meet their requirements without in any way clashing their Sunday maximum demand with the ordinary week-day maximum load on the station. This also applied to other classes of consumers who were willing to use their demand at other hours throughout the week than the usual lighting hours. Every class of consumer, who used energy during these ordinary and week-day lighting hours, should certainly be charged on the maximum demand system, which was really the fairest all round to the consumers as a whole, and also to the department from a strict business point of view. The following suggestion might, however, overcome the difficulty:—All churches which agreed to pay an increased meter rental of £1 per annum might have their demand indicators short circuited on Sundays, and thus have their accounts based on the week-day maximum demand, which, in all probability, would be so much less than their Sunday maximum as to make a very material difference in their annual accounts. This principle, if they would accept it, ought also to be extended to all other classes of consumer who on week days were willing or likely to take a supply only at other than the ordinary hours of lighting. Such an arrangement would meet perfectly the requirements of printing offices of morning dailies, and such like, and those who agreed to this method of obtaining their supply would, for an extra rental of £1 per annum, be provided with a time switch which would auto-

matically prevent the demand being registered except during the usual lighting hours. The advantage of the above suggestion was, that while strictly adhering to the correct principle of the maximum demand system of charging, it fully met the requirements of churches, midnight and daily users of electrical energy. In conclusion, therefore, he would strongly advise no departure from the present system of charging, except on lines similar to those he had indicated above. The Committee approved the recommendation contained in the report. A letter was read from the Westminster Supply Company, requesting the support of the Committee to the application of the company for an alteration to the proviso to Clause 6, Section B., of the Board of Trade regulations of March 4th, 1896. It was resolved that the town clerk should write to the Board of Trade, in support of the application, so as to provide for an appeal to the Board in cases in which an alteration of the standard pressure in a whole district was prevented by the refusal of consent by a small proportion of the consumers in such district.

Canterbury.—The T.C. has instructed Mr. Hammond to proceed with specifications, &c., for extensions of the electricity works.

Cardiff.—A proposal of Alderman Carey's, that the Lighting and Traction Committees should be amalgamated, has been discussed by the members of the two Committees without material result. The engineers of both systems have been asked to report on the present and future capabilities of the existing station and of the one under construction.

Dolgelly. — The U.D.C. has decided to institute inquiries as to the cost of carrying out a scheme for supplying electric light to the town. A Manchester syndicate has already made a proposal to the Council.

Dukinfield.—The new municipal buildings are to be fitted up with electric light. The contract has been secured by Messrs. D. Firth & Son, of Manchester and Dukinfield. This is the first practical step which has so far been taken in connection with the new joint municipal enterprise.

Gorton.—The D.C. is becoming anxious as to the possible revocation of its prov. order next June, and has set inquiries on foot as to the probability of obtaining a supply of electricity from Stretford.

Halifax.—The T.C. has decided to make a new departure with regard to the Electricity Department. Hitherto the electricity works and the gasworks have been controlled by one committee, but, owing to the enormous development of the demand for electricity consequent on the extension of the tramways, it was decided at the meeting on Friday last, when the various committees for the year were reconstituted, that the electricity department should be separated entirely from the gasworks section and joined to the tramways department, under the control of one committee.

Hampton Wick.—At a meeting of the U.D.C. last week it was decided to consent to the application of the Richmond Electric Light and Power Company for a prov. order for the district. The Council will have the right to purchase on the following conditions:—

(a) At any time before the expiration of 42 years the Council may purchase by paying such a sum as will produce, at 3½ per cent., a perpetual annuity of 5 per cent. upon the capital expended by the company.
(b) If purchased within 10 years, the Council shall pay in addition a sum equal to a dividend of 5 per cent., less the aggregate of any dividends declared.
(c) At the expiration of 21 years the Council may purchase on paying the value of the undertaking plus the value of the goodwill.

The company will supply, from its Richmond generating station, current for private consumers at 6d. per B.T.U., and will maintain public lamps at £3 per annum, inclusive. Previous negotiations with the Kingston Corporation were entertained, but the Corporation quotation was 8d. per unit.

Hampton (Middlesex).—On Tuesday the U.D.C. received notice of two forthcoming applications for prov. E.L. orders for their district, viz., by the Richmond Electric Light Company and Edmundson's Electricity Corporation, Limited.

Hindley.—The U.D.C. has filed notice of intention to apply for a provisional order.

Hendon.—The D.C. has passed a resolution asking the L.G.B. to sanction a £36,400 loan for electricity works. This sum does not include cost of site, which has not been settled, and it is only for the compulsory area laid down in the prov. order. Mr. Robert Hammond is the consulting engineer.

Holyhead.—The experts who examined the flow of water through "Pont Lasinwan," with a view of utilising it to generate electricity, have guaranteed sufficient power to provide for 3,000 8-C.P. lamps.

Keighley.—On Friday last the Mayor laid the memorial stone of the electricity works which are now in course of erection. The works, which are estimated to cost £34,600, will include offices and engineers' rooms, engine and boiler houses, and battery room. The machinery will consist of three steam dynamos of 800-H.P., but accommodation is to be provided for 3,000 H.P. without altering the engine room. Space is provided for six Lancashire boilers. The distributing network will be laid on the three-wire direct current system, with a supply pressure of 230 volts. Mr. J. M. Smyth is the borough electrical engineer, assisted by Mr. H. Chilvers.

Limerick.—The T.C., which recently failed to obtain the sanction of the L.G.B. to a loan of £22,000 for electric lighting purposes, has obtained an extension of the prov. order for 12 months from now.

Llandilo.—The U.D.C. has applied to the L.G.B. for leave to borrow a sum of £3,500 in connection with the electric lighting scheme.

Manchester.—At a meeting of the Electricity Committee, held at the Town Hall on Wednesday afternoon, Dr. Bishop was elected chairman, and Councillor John Phythian deputy chairman. Dr. Bishop took an active part in the movement which led to the appointment of a sub-committee of the Electricity Committee to inquire into the management of the electricity department. Mr. Wordingham, the chief electrical engineer, has intimated his intention not to renew his engagement, which expires in March next. This has been treated by the committee as a resignation, and duly accepted.

Mansfield (Notts.).—The T.C. last week resolved to promote a Bill in the next session of Parliament embodying powers to supply electricity for lighting and traction purposes.

Mountain Ash (Glam.).—Mr. R. Hammond has been engaged by the U.D.C. to report on the question of electrical supply in the district.

Normanton.—The U.D.C. recently decided to oppose the application of the North British and Northern Counties Electric Supply Companies for a provisional order to supply the town with electric light, and to make application for an order themselves. Since then, however, circumstances have arisen which make other arrangements desirable. A special meeting of the Council has been held to meet a deputation from the United Kingdom Tramway, Light Railway, and Electrical Syndicate, Limited, of Westminster, who have a scheme in hand for connecting Normanton, Castleford, Pontefract, and Nottingley with electric tramways and electric light; the proposed area will include Altofts, Whitwood, Fryston, Featherstone, Sharlston, Streethouse, Snydale, and Warmfield. It is intended, says the *Leeds Mercury*, to form a sub-company, to be named the West Riding Company, and the offices will be at Leeds. The maximum rate for the tramways will be 1d. per mile for ordinary passengers and ½d. per mile for workmen's cars, and the maximum price for lighting is to be 4d. per unit for public, and 6d. for private use. The syndicate will also undertake the conveyance of goods by night. At the special meeting of the Council the scheme was warmly supported, conditionally that on the consent of the other authorities being obtained, the work will be proceeded with on license pending the granting of the provisional order.

North Metropolitan District.—Last April the Edmonton D.C. passed a resolution to apply to the B. of T. for a prov. order to supply electric light. At a meeting on Tuesday, the chairman stated that at a conference of delegates of the Councils interested in the joint scheme, the opinion was expressed that the Bill which is being promoted would be strenuously opposed, and the fact that the Council was acting independently in seeking an order, was likely to be advanced as a reason why the Bill should not pass. The Council unanimously agreed to rescind the resolution.

Oban.—On 3rd inst. it was agreed to recommend an application for a prov. order for the electric lighting of the town.

Pickering.—The U.D.C. has passed a resolution assenting to an application to the B. of T. by an electricity supply company for an order empowering it to establish works for supplying electricity in the district.

Pontypridd (Glam.).—Mr. R. P. Wilson, of Westminster, has been selected as consulting electrical engineer to the U.D.C. to report upon an electric light scheme, and a prov. order is to be applied for by the Council.

Rathmines.—Much dissatisfaction is expressed by the ratepayers on account of the large outlay for electric lighting, which already exceeds the original estimates (£50,000) by £20,000. The D.C. has adopted a recommendation of the E.L. Committee that a third steam dynamo should be obtained, at an estimated cost of £7,500, on account of the numerous applications for electricity supply.

Roundhay. — The Roundhay and District Electric Lighting Company notify their intention to apply for a provisional order.

Saltburn.—Reporting upon the proposed purchase of the electric light installation, Mr. Urwin stated that he could not recommend the Council to purchase from the Assets Company at the sum of £10,000, but at £8,000 it might have been advisable. It was agreed to ask the Assets Company if they were prepared to accept the latter amount.

Sheffield.—The electrical engineer, Mr. S. E. Fedden, has presented a report to the E.L. Committee on the arc lighting of the Leeds markets; 80 enclosed alternating arc lamps of the "Reason" type are used, and 40 are on order for new buildings. The Markets Committee pays 3½d. per unit, and Mr. Fedden states that the results are highly satisfactory. Mr. Fedden has also drawn up a report on his Continental tour, from which we propose to make a few extracts next week.

Shrewsbury.—The T.C. is extending the street lighting with arc lamps.

Swindon.—Mr. G. J. Churchward, J.P., M.I.M.E., M.I.C.E., the first mayor for the newly formed borough, is taking a deep interest in the movement for getting an electric light installation in the town, and this will be one of the first undertakings the new Council will have in hand.

Royton.—Preliminary steps are being taken by the D.C. for laying down an electric lighting plant and constructing tramways.

Teddington.—The U.D.C. have instructed Mr. J. E. Edgcombe, electrical engineer to the Kingston Corporation, to prepare a scheme for electric lighting in pursuance of the Council's application for a prov. order. The Kingston Corporation have consented to this on Mr. Edgcombe receiving a fee of 50 guineas.

Thornhill.—A letter has been received by the Thornhill D.C. from Messrs. Bennett & Ward-Thomas, Manchester, intimating that a syndicate intends to apply to Parliament next session for powers to supply the Council's area with electricity.

Trowbridge.—At a special meeting of the U.D.C. on Monday, it was unanimously decided to apply to the B. of T. for a prov. order. At first only the principal business streets will be supplied, for which purpose it is proposed to lay down a plant capable of serving 3,600 8-c.p. lamps burning at one time, or a total of 5,400 8-c.p. lamps fixed. Only a small portion of the town (requiring eight arc lamps) will have public street lighting at the outset. Provision will be made for extension down side streets and into the residential quarters. Mr. David Stevenson, who is advising the Council, estimates the capital cost at £17,000; working cost, including management, &c., £1,227; allowance for interest, depreciation, and sinking fund, 5½ per cent. on £17,000; £935—total £2,162. He estimates the total revenue at £2,274 14s. (including £1,890 from lighting, £250 from motors, and £70 from meter rentals), showing a net profit balance of £112 14s. This result the engineer expects to be realised two years after the borrowing of capital and commencing to lay down the works.

West Bromwich.—The E.L. Committee of the T.C. report having had before them 64 applications for the appointment of borough electrical engineer, and recommend that Mr. J. H. Wray, of Blackpool, be appointed to the position, at a commencing salary of £250 per annum.

West Hartlepool.—The T.C. has approved a recommendation of the E.L. Committee that Mr. J. G. Steel be appointed one of the assistant electrical engineers, and that the sub-committee interview Messrs. C. H. Robson (of Huddersfield) and C. Follenfont (of Bradford) and appoint one of them to the other vacant post.

Whitley and Monkseaton.—Notice is given in the *London Gazette* of an application by Mr. A. G. Robson, A. W. Dixon and J. A. Jeckell for electric lighting powers for the Whitley and Monkseaton districts.

Wigan.—In a report to the E.L. and Tramways Committee of the T.C., Mr. H. C. Bishop, electrical engineer, states that he has received applications for 9,000 8-c.p. lamps, and promises for 6,000 more, in addition to the tramway requirements. He recommends that orders be placed at once for two more steam dynamos, although those at present on order have not yet been delivered. Special stress is laid on the importance of opening the works at an early date; the temporary plant, which has been in use for 11 months, is fully loaded, and it was suggested, and approved; that Mr. Bishop should visit the works of the various contractors who are behindhand, and see what can be done to hasten matters.

Wimbledon.—At a special meeting of the U.D.C. last week it was decided to apply for Parliamentary powers to supply electrical energy, apparatus, and fittings to neighbouring districts.

Worthing.—At a meeting of the E.L. Committee last week, Alderman Patching asked the chairman if he could explain to the Council what a "milking booster" was. Councillor Raffety replied that he understood from the engineers that they occupied the same position to electric lighting work that champagne occupied in reference to a dinner. We cannot say whether the reference is to their "fizzy" effect on accumulators, or to the rejuvenation consequent upon their use.

ELECTRIC TRACTION NOTES.

Aberdeen.—The Tramways Committee convener stated that some time ago the committee had decided to ask Messrs. M'Elroy & Grunow, and Johnstone & Londale if they would be prepared to put in a section of a contact system as an experiment in Aberdeen. He intimated receipt of a letter from Johnstone and Londale saying that they were to put down an experimental line in England. Mr. Wilkie said, however, that M'Elroy & Grunow, who had come over from America, were waiting in the Town House and were prepared to put down a line in the city. Messrs. M'Elroy and Grunow were called into the committee room, and explained their system in detail, and submitted a report, stating that they were prepared to lay at their own expense—600 yards double track—of their system, and allow it to be put to all the tests applicable to tramway traffic. If it were not considered satisfactory to the Town Council, they were prepared to remove the line at their own expense. If the Council agreed to retain the track, they were prepared to hand it over for £1,400. The committee unanimously agreed that the firm should have an opportunity of putting down the experimental line from the foot of Constitution Street to the Bathing Station and Promenade, a distance of 600 yards. The system will be in operation by the beginning of May next.

Brighton.—The Tramways Committee reported to the last meeting of the T.C. the receipt of a letter from the Board of Trade, stating that they approved provisionally of the system of traction proposed to be employed on the Corporation Tramways, subject to any requirements which might be considered necessary on the inspection of the completed works. The plans showing the proposed mode of construction had been returned duly endorsed on behalf of the department, but the board were advised that the rails were rather shallow.

Bournemouth.—A B. of T. inquiry was held on Tuesday by Mr. A. P. Trotter, respecting an application of the Corporation for sanction to borrow £174,750 for the construction and electrical equipment of the tramways authorised by the Corporation Tramways Order, 1900. The town clerk (Mr. J. Druitt, jun.) and the borough surveyor (Mr. F. W. Lacey) represented the Corporation, and Mr. E. M. Lacey (of Messrs. Lacey, Clirehugh & Sillar) was in attendance, representing the engineers for the scheme. Mr. A. E. Francis Francis opposed the application on behalf of the owners of property proposed to be taken for the purposes of a generating station. Mr. E. M. Lacey explained the plans to the inspector, and stated among other items that the longest run from the depôt would be two miles —to the County Gates—and that the highest gradient was under 1 in 14. The inspector said that for anything over 1 in 14 the railway department required slipper brakes. He was not quite sure of the limit, but he thought it was somewhere about 1 in 14. The town clerk said that the Poole and District Electric Traction Company had a light railway order to construct a tramway from Bournemouth to Poole, and it was in course of being laid. The Christchurch and Bournemouth Company had powers in their order last session to construct a tramway on the east. The two companies had running powers over the Bournemouth main line from east to west. The opposition to the position of the power station having been heard, the question of repayment of loan was mentioned. The inspector said that the statutory terms were for repayment of the amount borrowed for the permanent way and buildings 30 years, electrical equipment 20 years, and cars 15 years. When was it proposed to commence? The town clerk said that if the Corporation did not complete the works within two years from August last the other companies would have the power to step in and construct the line. As soon as the Corporation got sanction they would at once proceed with the work. The inspector then went to visit the various sites.

The gauge throughout will be 3 feet 6 inches. The total length of lines already authorised is:—Double lines, 3 miles 57 chains; single lines, 6 miles 51½ chains. The system is the overhead trolley. It is proposed to erect a generating station and car-sheds in a vacant plot of land situated at the junction of Southcote and Vale Roads, known as the Cumberland Estate, together with a piece of land, already in possession of the Corporation, adjacent. Electricity will be generated by three 256-kw. traction generators. Steam will be provided from three Lancashire boilers 30 feet long. Estimate No. 1, for traction station, is £30,734, including £7,000 for buildings and £7,950 for traction generation. Estimate No. 2 is for cars and cars depôt, £30,800. It includes 38 41-passenger double-deck cars complete, £22,800; one car depôt for 40 cars, repair sheds, &c., £5,200; fees and contingencies, £2,800. No. 3 Estimate, for the track and permanent way, is £85,006 19s. 6d. The cost of the double lines will be £12,269 17s. a mile, and of the single lines £4,776 5s. a mile. No. 4 Estimate is £23,430 for overhead equipment.

Cardiff.—The *Western Mail* says that in consequence of the action taken by Alderman Sir Thomas Morel, who at a recent meeting of the Corporation objected to tramway rails being obtained from America, the Dowlais, Ebbw Vale, and Cyfarthfa steel and iron companies have announced their intention of tendering when the next contract comes out. Only 1,000 tons have as yet been ordered out of 7,000 to 8,000 tons which will eventually be required.

Crewe.—The T.C. is about to make application to the Light Railway Commissioners for an order to carry out a scheme of light railways in the borough, and this will be worked in connection with the electric light undertaking.

New Malden.—At a special meeting on Tuesday the U.D.C. decided not to oppose the Bill of the London United Tramways, Limited, after hearing the personal explanation of Mr. Clifton Robinson, who agreed to slight modifications of the original plans.

Pontypridd.—The D.C., who came to an arrangement with the British Electric Traction Company prior to their first publication will now apply for permission to construct a light railway from Treforest and Cilfynydd to their boundary at Havod, which is about a mile from Porth, the entrance to the Rhondda Valley.

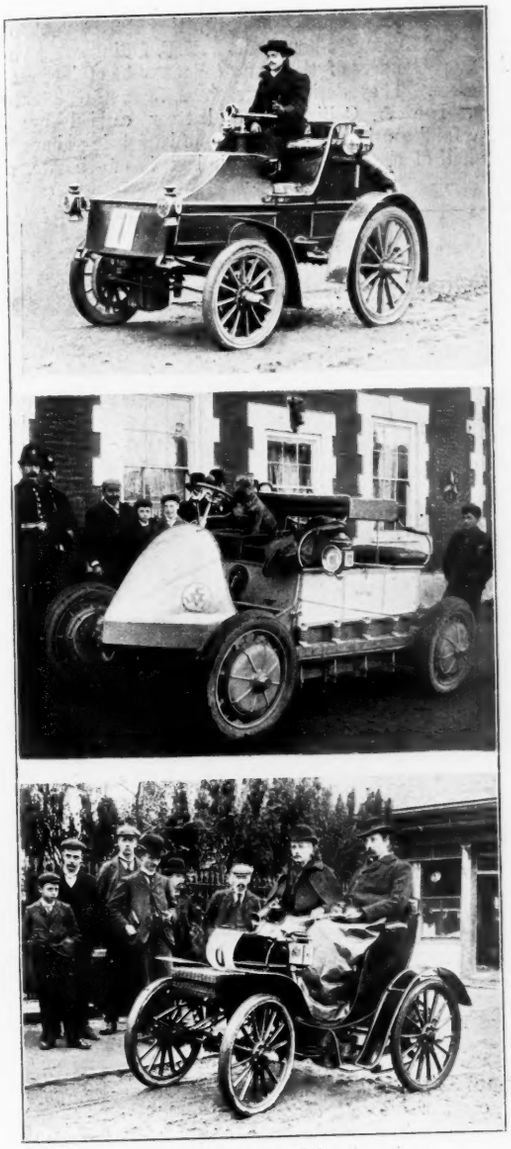
(*Continued on page* 793.)

ELECTRIC MOTOR CAR TRIALS.

Our readers may remember that some weeks ago an announcement appeared in the Electrical Review concerning certain trials of electric motor cars, to be made within 50 miles of London, under the auspices of the Automobile Club.

The conditions were briefly these:—

Each car must be provided with a driver, whilst the club provides a judge to accompany the car. Instruments are to be provided so that the judge may take observations during the run.



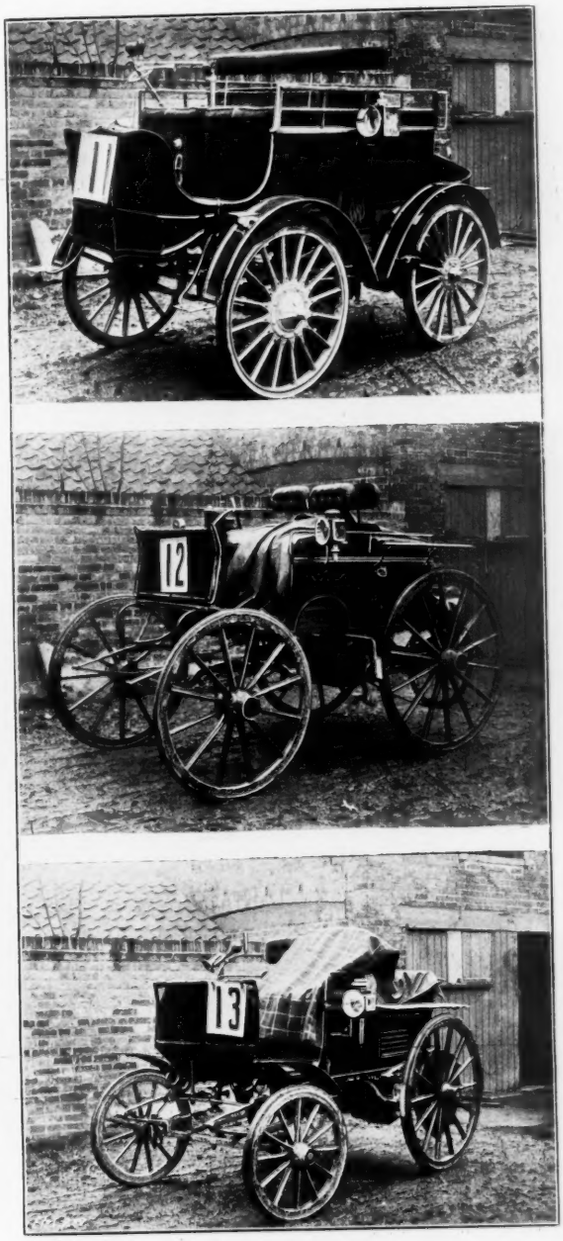
Cars Nos. 1, 2, and 8.

No repairs are allowed to cars during the trials.

Any car not completing its first day's trial is prevented from further competing in the final.

The vehicles were supposed to have arrived by 6 p.m. on Monday, the 5th, to be charged at the station of the Chislehurst Electric Supply Company, in which neighbourhood the club had finally decided to run the trials, but it was early on Tuesday morning before the last car put in an appearance. It was found impossible to comply with the rule that each cell should be run down to 1·8 volts before being charged for the first run, as many owners maintained that their cells never discharged lower than 2 volts.

Thirteen cars were entered in the following list, which gives the amount of charge the owners requested should be supplied to them:—



Cars Nos. 11, 12, and 13.

The Leecoll Electric Battery Company.

No. 1.—One car, 224 volts 200 amperes for 2 hours.

„ 2	„	„	„	„	„	„
„ 3	„	192	„	„	„	„
„ 4	„	128	„	55	„	„
„ 5	„	„	„	„	„	„
„ 6	„	„	„	„	„	„
„ 7	„	128	„	75	„	„

The National Motor Carriage Syndicate.

No. 8.—One Joel car, 100 volts 20 amperes for 10 hours.

Carl Oppermann.

No. 9.—One Oppermann car, 100 volts 25 amperes for 7 hours.

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had come over from America, were waiting in the Town House and

(*Continued on page 793.*)

The Electric Motive Power Company.

No. 10.—One car, 100 volts 42 amperes for 5 hours.
„ 11 „ „ 50 „ „

The Canadian Electric Motor Company.

No. 12.—One car, 100 volts 20 amperes for 10 hours.

The Electrical Undertakings Company.

No. 13.—One car, 100 volts 20 amperes for 10 hours.

The entry of the Leecoll Battery Company was evidently with the object of testing cars of various foreign makes fitted with Leecoll batteries, but numbers 5, 6, and 7, failed to put in an appearance. No. 9 was also withdrawn from the competition at the last moment, owing to the sad fatal accident which befell Mr. Oppermann's eldest son on the previous Saturday.

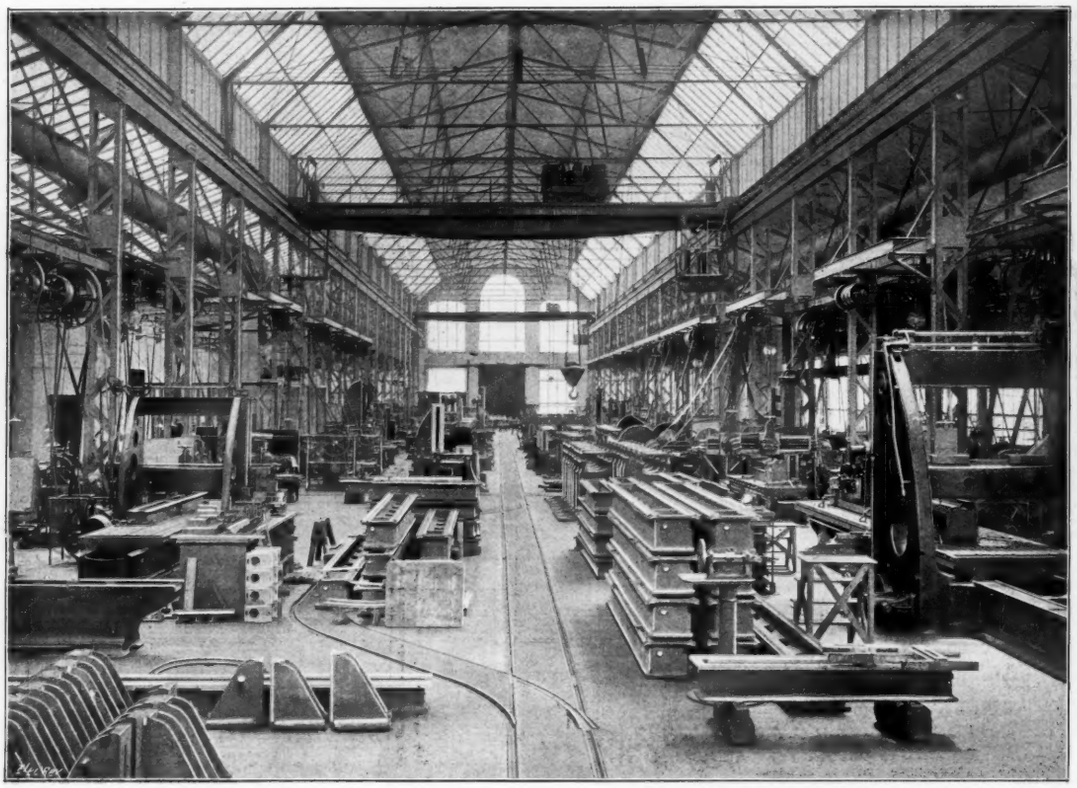
The cars having received their full charge during Monday night, started on Tuesday morning, at intervals of about 15 minutes, in the direction prescribed by the club. Rain had fallen to make the roads in the worst possible state for hill climbing, whilst a strong wind blew the whole day.

succeeded in moving his heavy vehicle up the remaining portion of the hill. The judge seemed to have considerable doubts as to his permanent seat upon the car during the playful manœuvres of its jehu. The motors responded well to the abnormal rush of current put through them, which was 60 amperes each at 130 volts.

Hill climbing was now at an end, and two miles more, by way of St. Paul's Cray Common, brought the first day's official run of 34¾ miles to an end at the charging station.

No. 1, "The Powerful," availed itself of the extra optional run allowed by the club, and altogether completed 61 miles without any apparent effort. The cells discharged 275 ampere-hours, although they are only supposed to contain 270 ampere-hours, the E.M.F. falling to 80 volts.

A few particulars of these new cells may be of interest to our readers. They derive their name from the patentees, Messrs. Lee & Collis. The battery carried by the "Powerful" consisted of 60 cells, one half being above the other half of the number. Each box is of ebonite, and



Ludw. Loewe & Co.—Fig. 10.—The Machine Hall. (See p. 788.)

The direction taken was through Perry Street to Foot's Cray, on to Swanley and Farningham, along the high road to Maidstone, to Wrotham and Borough Green, to Ightham, and through Seal on to the "Bat and Ball," Sevenoaks station, until the high road was struck after passing along the Riverhead Road.

Turning sharp to the right up the long Poll Hill incline, the cars faced home through Green St. Green, and keeping to the right were soon in Orpington.

After passing through the village and turning to the left, up a short, but very steep hill of 13 in 100, the drivers found that a longer and almost as steep incline of 12 in 100 awaited them.

Being almost at the end of the run, this hill caused considerable trouble to many of the competitors.

No. 1 was undoubtedly saved by its driver, whose manipulation of his car was throughout the admiration of all. Finding himself in a tight place, he reversed his motors, and running the car heavily against the bank at the side of the road, took advantage of the rebound to assist in starting forward; by putting his levers to full speed ahead, he

measures 9⅜ inches × 7⅞ inches × 11½ inches deep outside. The weight of each cell complete, with electrolyte, is 56 lbs.

The normal terminal pressure of the battery is 145 volts, and the yield is claimed to be 12 watt-hours per lb. of gross weight.

Each cell, when fully charged, gives 2·55 volts on open circuit.

The positive element is of ordinary lead peroxide, sealed up in a porous pot similar to a Leclanché cell, the pots being about 11 inches long × 1¼ inches diameter. Ten of such pots are joined up in parallel to a backbone of lead, and three similar sets form one cell, all, of course, joined up to a common terminal. The negative pole consists of fine copper wire gauze, on which zinc is deposited; this surrounds the outer pots, and is drawn in tightly between each porous pot. It is insulated entirely from the pots by rods of glass at short intervals. The makers claim that by reason of this construction it is impossible to short-circuit the cells by any amount of jolting.

The normal charging rate of the cell is 150 amperes, and the normal discharge 90 amperes, although there seems

ance. It was found impossible to comply with the rule that

No. 9.—One Oppermann car, 100 volts 25 amperes for 7 hours.

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to be nothing to prevent heavier discharges for short intervals, as buckling is impossible. We have already mentioned that in coming up the Orpington Hill at the end of the official run on the first day of the trials, a current of 120 amperes was taken out of these cells. The makers do not object to a heavier charging rate, as will be seen by the rates published with each car on the entry list. It is also claimed that short-circuiting of the cells is no detriment to their life. Considering that these batteries were made up in a hurry at the London works in order to take part in the trials, the results must be considered very satisfactory. There are small defects, no doubt, at present, which seem to be rather mechanical than anything else.

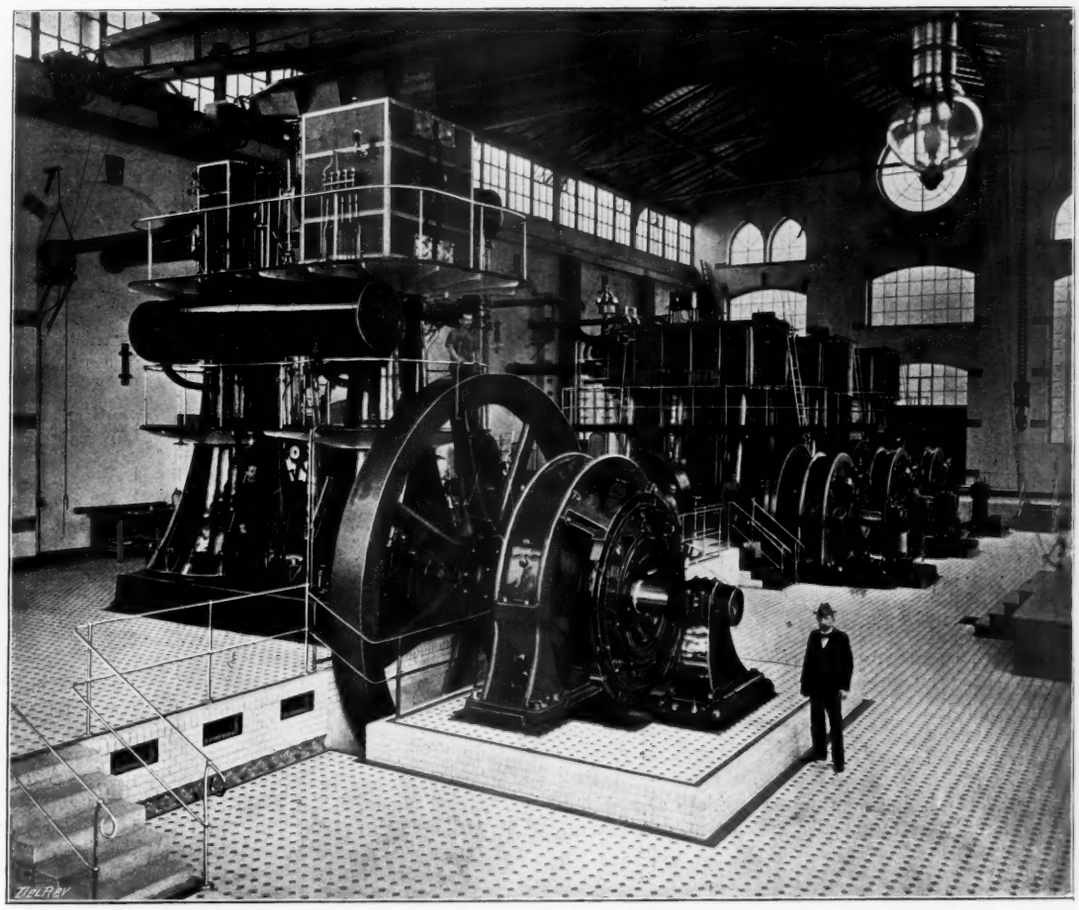
The charging of the cells in so short a time is undoubtedly a great advantage, and it would seem that this type of cell may have a great future before it for traction and other purposes.

works into an inside spur wheel of about 24 inches diameter, fixed to the car wheel.

The motors are of special design, and we are not allowed at the present time to say more than that they are of the four-pole type.

The controlling switch enables changes to be made in the motors, as well as putting them in parallel and in series. The cells can also be put in parallel or series. A great advantage is the recuperation of the cells when going down hill: the motors then become generators, which has the double advantage of acting as a powerful brake. In one instance, during the trials, these motors were giving back 60 amperes, at 150 volts.

No. 2, Mr. Hart's "La Toujours Contente" hardly maintained the reputation its name would lead one to suppose it possessed. When coming towards one, it somewhat resembles a torpedo destroyer on wheels, or possibly it might be regarded as a snow plough. It strongly objected to the hills on the



Ludw. Loewe & Co.—Fig. 11.—The Power House. (See page 788.)

We should like to see something better than the loose india-rubber cover to the cell and the bands of rubber which are intended to check the splashing of the acid. All new inventions, however, must have a beginning, and we look forward with much interest to future developments of this battery.

The "Powerful" car is the manufacture of the Krieger Company, in Paris, and its construction is worthy of note. It is built probably for experimental purposes only, and accommodates only two persons, although it might easily carry four.

There are two tiers of cells, as already explained, the top set being removed during the charging of the battery.

The front wheels are separately driven through spur gearing by two motors; these are suspended on heavy springs, and are below the axle of the wheels. By this arrangement the starting current is reduced to a minimum, and the motion at starting is perfectly easy. The pinion of the motor

first day, and was consequently prevented from taking further part in the trials.

This car was taken out again upon a non-official run, and showed wonderful speed when it was allowed to sprint; it was unfortunate, however, once more in puncturing a tyre near Dunton Green Station.

No. 3, of Austrian make, also failed to negotiate the hills, which was no doubt accounted for to some extent by the greasy nature of the roads.

No. 4, a large delivery van, was entirely unsuited to the class of country, and only fit for parcels delivery in towns.

No. 8.—A small phaeton for two on light roads.

No. 10.—A four-wheeled dog-cart. The motor was burnt out on the first day's run, through calling upon it to do more than it was constructed for.

Nos. 11, 12, and 13 were all of similar construction.

The first day's trial was the severest test throughout the week, the second day, Wednesday, being left to Nos. 1, 8,

11, 12, and 13, which started once more on greasy roads at about 11 o'clock, upon a route differing from that of the previous day, passing through Orpington, Cudham, Knockholt, Stonehouse, and back *viâ* Orpington to Chislehurst after climbing several steep hills. This run of 30 miles was not considered by the drivers to be nearly so severe as on the previous day, especially as the roads were in better condition; all five cars therefore availed themselves of the optional runs permitted under the rules of the Automobile Club, of seven additional miles. During the evening rain again descended heavily, which promised badly for the morrow.

On Thursday the same cars went out, and No. 2 accompanied them as far as Dunton Green, where the second mishap already mentioned occurred.

The course was 30 miles, in much the same direction as on the first day—through Farningham, Swanley, past the "Bat and Ball," Sevenoaks, to Dunton Green, and home by way of Orpington.

On account of the bad state of the roads on Tuesday, the committee decided that the test of distance was not a fair one, and they determined that Friday's run should be on a less hilly route; the direction chosen being from Chislehurst to Sidcup, Eltham, through Blendon to Bexley and back to Sidcup. This was to be repeated as often as the driver thought fit, and then he was to return to Chislehurst. No. 1 completed 69 miles, No. 13 38½ miles, whilst each of the other three cars completed about 30 miles.

No. 1 was the only car of any novelty which completed the trials. We regret that No. 2 was disqualified so early in the tests, as the construction of the car was distinctly new, and it had points of interest, which we should have liked to have seen thoroughly tested. The motors are enclosed in the discs of the wheels, as will be seen in the illustration of this car on page 785.

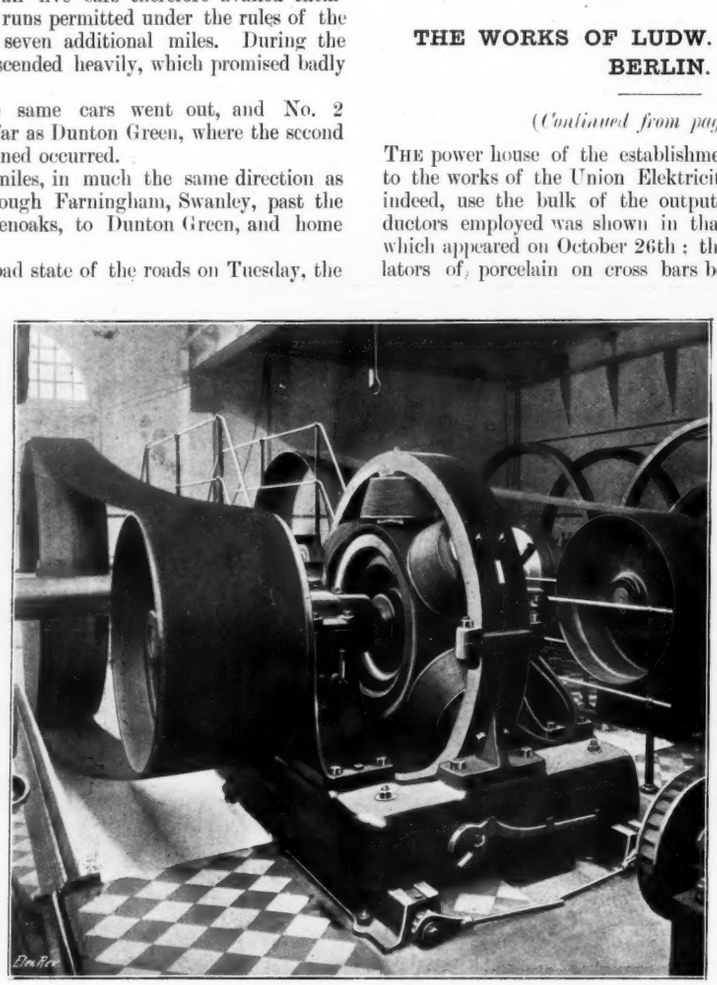
The trials as a whole will form food for the minds of electric car manufacturers to digest. So far as the design of British cars is concerned, we seem to be where we were when autocars were first allowed in the streets, which, after all, is not long ago, but our Continental neighbours, who had some years' lead of us, have certainly made greater strides in the right direction, for which we give them every credit.

Had the nature of the country over which the trials were to take place been known, several cars which were entered would have been replaced by more suitable ones, one car (No. 4) being merely for delivery of goods in towns.

A worse time of year could scarcely have been selected for the tests; the rain falling every night made the roads in the worst possible state.

The observers' reports on each car throughout the trials will no doubt be published by the Automobile Club, when the cost of running can be calculated.

If we take the case of No. 1 car, which took in 70 units before her 61-mile run, the cells being previously run down, and taking the car at 2·25 tons when fully equipped, to which should be added the weight of two persons, we have $\frac{70}{61} \times \frac{4}{9} = \cdot 51$ unit per ton-mile. Assuming that 3d. per unit is paid for current, the cost of running comes to 1·52d., or slightly over 1½d. per ton-mile.



Sydney Trams: 150-kw. Generators at Rushcutter Bay.

THE WORKS OF LUDW. LOEWE & CO., BERLIN.

(*Continued from page* 710.)

The power house of the establishment also supplies power to the works of the Union Elektricitäts Gesellschaft, which, indeed, use the bulk of the output. The system of conductors employed was shown in that portion of this article which appeared on October 26th: these are carried by insulators of porcelain on cross bars between two poles, or on brackets projecting from the walls. Current is distributed at 500 volts.

Particularly noticeable is the arrangement of the water tanks, which are built at about half the height of the two chimneys, the tanks encircling the chimneys and making use of them for this double duty in a novel and, we believe, patented manner. The system was to us quite a novelty in water towers, and probably calculation would show that the stability of the chimney is no worse but rather better.

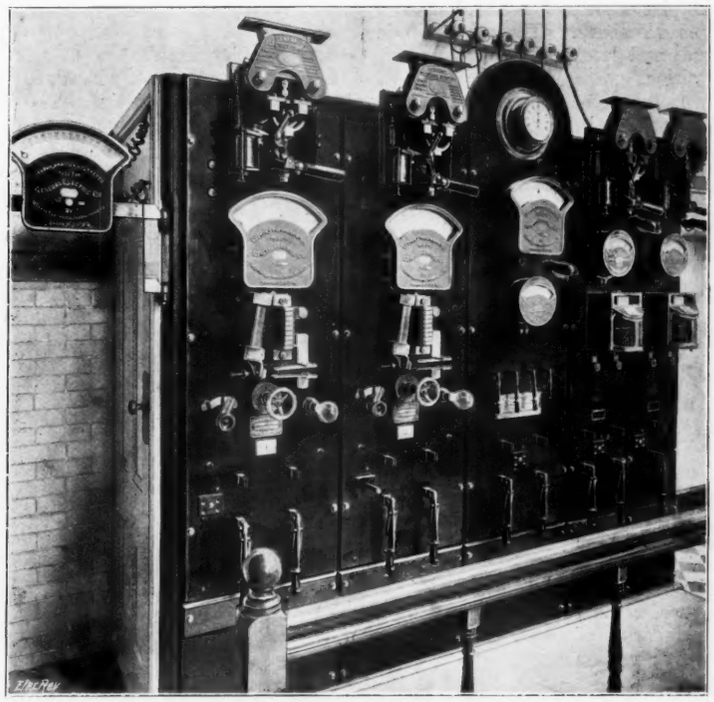
The total capacity of the power station, of which we give an inside view in fig. 11, is 1,525 kw. There is one unit of 100 kw., two of 300 kw., and one of 525 kw. distributing power at 500 volts, as well as one unit of 300 kw. and 110 volts for incandescent lighting. There are six water-tube boilers, each with 1,560 square feet of heating surface on the Gehre system, and two of 3,120 square feet each (Babcock & Wilcox). The steam pressure is 170 lbs. per square inch. Each engine is direct coupled to its dynamo. There are three vertical triple-expansion engines of 500 i.h.p. each; they run at 100 revolutions per minute, and were built by the Görlitzer Maschinenbau-Anstalt in Gorlitz. These cylinders are 17¾ inches, 28 inches and 46 inches, with a stroke of 37½ inches. There is a compound Corliss 850 i.h.p. vertical engine, by Allis, at 100 revolutions per minute, with 21-inch and 42-inch cylinders × 42-inch stroke, and a tandem horizontal 125 h.p., 250 revolutions per minute, by Macintosh and Seymour. All the dynamos are multipolar compound; the large one has 10 poles, and so has the 300-kw. lighting dynamo.

There are two independent switchboards, one for incandescent light distribution, with one generator panel and four 2-circuit feeder panels, and the other for the 500-volt distribution with four generator panels and nine feeder panels, and one arc light panel, the arcs being in series of five on the 500-volt mains.

The lighting watt-hour meter has 2,500 amperes capacity, and each of the eight circuits has a separate meter. Each feeder

panel has its automatic circuit-breaker and two double-pole switches.

The arrangement of the power board is such that the generators can be paralleled, and any generator, or group of generators, can be connected to either of the two sets of bus bars. This prevents the works from being affected by the serious fluctuations in the testing work of the Union shops. The power feeder panels have each an automatic cut-out and double-pole double-throw switch for connection to either set of bars.



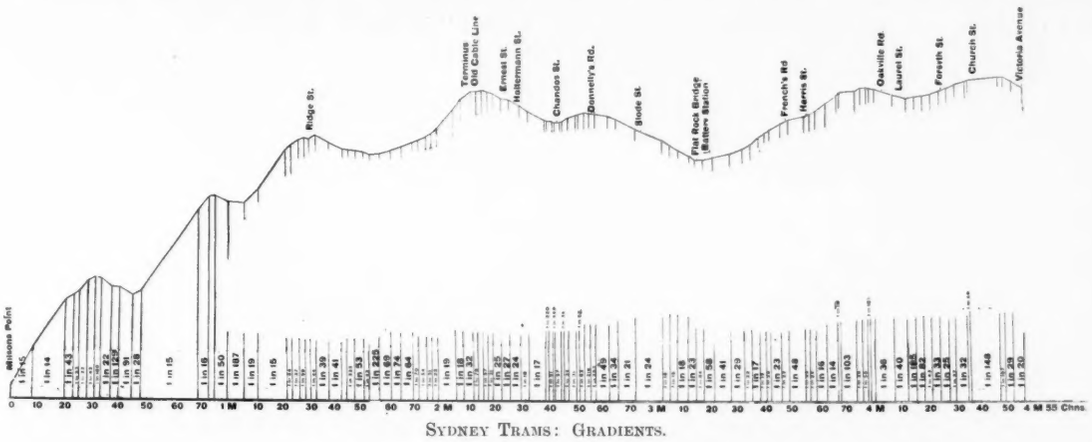
Sydney Trams: Switchboard at Rushcutter Bay.

Distribution of power and light is effected on the two-wire system, with separate feeders to each building, all of which are provided with a central switchboard. The main cables are supported as above stated, the poles being of iron. The engine room is commanded by a 10-ton traveller. There are 45 motors of a total of 637 H.P. in the works. The foundry is a building brought wholly from America.

There are two cupolas grouped together; they discharge into a common chimney through a spark chamber. The iron is run out into a receiver in which it is stirred or mixed, and thence run into the ladles. The charging floor is above the running floor and is well provided with all necessary weighing apparatus, &c. There are two bays of 230 feet and two of 97 feet, all being 49 feet wide. Six cupolas are to be installed when the foundry is complete and able to secure outside work also. They will have a capacity in pairs of two 10,000, two 8,000 and two 4,000 lbs.; 15-ton cranes can be ultimately fitted, but so far there are cranes of 3, 5 and 10 tons. Cleaning rooms are provided and the foundry includes also the pickling and tumbling apparatus. It is the intention that, when the foundry is complete, it shall be equal in quality to the remainder of the works, replete with machine moulding plant and doing such work that its products shall require the minimum of machining, it being one of the aims of economical manufacture to remove as little stock as possible. This is only possible with good patterns and good moulding. The foundry is as well supplied with wardrobes and lavatories for the men, as the other departments, and in addition has shower baths.

The large cupolas are of such size that the charging floor is 21 ft. above ground; the inside diameter is 40 inches, the outside diameter 63 inches. Air blast is supplied at 12½ ounces by an electric fan which absorbs 37·8 amps. when run at 2,350 revs. The average daily melt varies from 14,500 to 25,500 lbs., and the various sizes of cupola are used accordingly. About 0·15 per cent. of silicon is lost in the cupolas, and sulphur increases about 0·06 per cent. in the process. Special attention is given to the mixing of the irons. Thus the calculation of the cupola charge for July 6th last was made as follows: The previous day certain weights of very-thin, thin, medium, and heavy castings were melted, and their analyses of Si., S., and C. were made: from these was deduced the percentage of these important elements in the scrap for July 6th, namely, 2·30 per cent. of Si. and 0·115 per cent. of S.

Then for the mixture for thin castings; in this case the silicon is wanted to be 2·4 per cent. plus the loss found in the cupola of 0·1 per cent., making a total of 2·50 per cent. of silicon. To secure this result there was melted for July 6th for thin castings 30 per cent. of the scrap of July 5th with its remaining 2·29 per cent.; 17 per cent. of Alabama II. iron containing 3·32 per cent.; 18 per cent. from the Aguese pile 43; 15 per cent. of Clarence, and 20 per cent. of English hematite. This works out at 2·4996 per cent. of silicon. The sulphur in the mixture was respectively, ·115, ·029, ·012, ·037, ·104, or ·06794 per cent. Analysis taken in the middle of the heat showed 2·29 of Si., and ·125 of S., or a loss of 0·21 per cent., and a gain of ·057 per cent. Similar calculations and mixings are made for other sorts of castings. The very thin having 2·63 of Si., and ·119 S.


Missons Point
Ridge St.
Terminus Old Cable Line
Ernest St.
Holtermann St.
Chandos St.
Donnelly's Rd.
Slade St.
Flat Rock Bridge
Raglan Station
French's Rd
Harris St.
Oakville Rd
Laurel St.
Foresth St.
Church St.
Victoria Avenue
0 10 20 30 40 50 60 70 1 M 10 20 30 40 50 60 70 2 M 10 20 30 40 50 60 70 3 M 10 20 30 40 50 60 70 4 M 10 20 30 40 50 4 M 55 Chns.

Sydney Trams: Gradients.

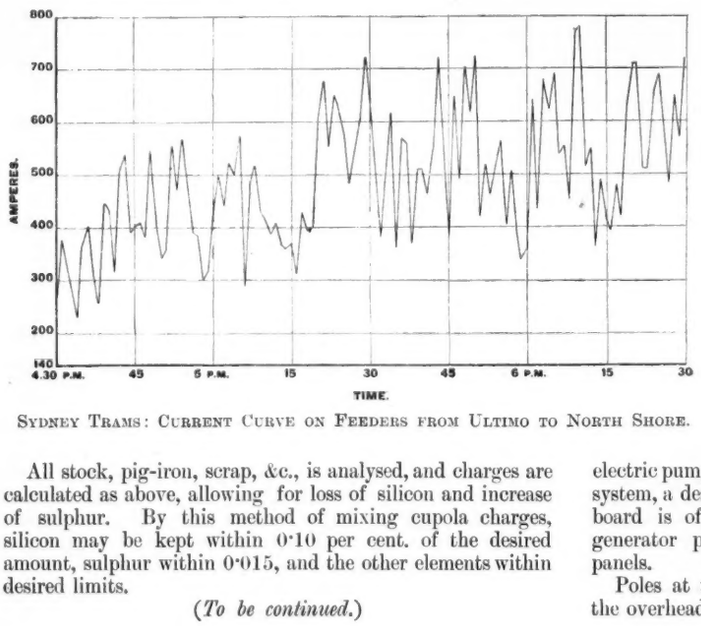
while the heavy castings from the large cupola had 2·29 per cent. of Si., and 0·087 per cent. of S.

Medium heavy castings are desired to run to about 2·39 per cent. of Si. of which 2·14 is left in the castings. All iron is analysed as it comes to the foundry by drilling 10 pigs in each car-load or 20 pigs out of a barge-load of 200 tons of foreign iron from Hamburg. The coke also is analysed, and various sands and loams are properly binned, and mixtures fixed for various purposes, as dried moulds, cores, and so on. When complete the foundry will be as interesting a department as any there is, and we commend the methods followed, especially the differentiation of the iron for thin, medium, or heavy castings, and the mixing of the charge as run from the furnace in a special vat before running it to the ladles, thus ensuring perfect homogeneity. In ordinary foundry practice, the suitability of the iron is fixed by the judgment of the foundry man, who arranges to cast light articles and heavy articles at different periods of the melt, the more refractory iron coming down later. This skill is not to be despised, but it is rarely available, and chemical analysis and method can always take its place.

The testing department and chemical laboratory are engaged at present in the chemical and physical examination of the iron castings, steel and oils used in the works, and there are in course of gradual establishment fixed specifications of materials as experience and investigation show what is the best for the work. For example: below are given the chemical and physical specifications worked to in the foundry in mixing iron for light machinery castings as referred to above.

Chemical Specifications for Light Machinery Castings.

	A.—Mixture for thin castings under 15 mm. thickness.		B.—Mixture for castings of an average thickness of 20 mm.		C.—Mixture for castings 30 to 50 mm. thick.	
	Limits allowed.	Analyses desired.	Limits allowed.	Analyses desired.	Limits allowed.	Analyses desired.
Silicon ..	2·45—2·65	2·55	2·30—2·50	2·40	2·15—2·35	2·25
Sulphur ..	0·07—0·10	0·08	0·07—0·10	0·09	0·08—0·12	0·10
Manganese..	0·30—0·70	0·40	0·30—0·70	0·40	0·30—0·70	0·40
Phosphorus	0·70—1·00	0·90	0·50—0·90	0·70	0·40—0·80	0·60
Combined carbon ..	0·30—0·50	0·40	0·30—0·50	0·40	0·30—0·50	0·40
Graphite ..	2·90—3·20	3·10	2·90—3·20	3·10	2·90—3·20	3·00



Sydney Trams: Current Curve on Feeders from Ultimo to North Shore.

All stock, pig-iron, scrap, &c., is analysed, and charges are calculated as above, allowing for loss of silicon and increase of sulphur. By this method of mixing cupola charges, silicon may be kept within 0·10 per cent. of the desired amount, sulphur within 0·015, and the other elements within desired limits.

(To be continued.)

ELECTRIC TRAMWAYS IN SYDNEY (N.S.W.)

By ARTHUR C. F. WEBB.

(Concluded from page 747.)

It is singular that the first electric lines were all feeders to cable lines, firstly, to the North Sydney cables, and secondly, to the Ocean Street line. The Rose Bay line, which, as formerly mentioned, is an extension of the Ocean Street cable line, is laid along a road which is particularly uncomfortable for any kind of mechanical traction, and it is doubtful if anything else but electric traction would work economically, as it is not only uphill and down dale, but it is as crooked as a dog's hind leg into the bargain. The line is at present only 1¼ miles in length, but 55 per cent. of the distance is composed of curves, the grades go up to 1 in 11, and it is quite the usual thing for the steepest grade to occur on the curve of shortest radius. The load is also a peculiar one, as the present terminus of the line, Rose Bay, is not only a popular holiday resort, 15,000 people having been carried on one holiday, but it is also extensively patronised on hot nights, so much so, that the night load curves might almost be utilised as a recording thermometer. The time table gives a 20-minute service from 7.30 to 2 p.m., followed by a 10-minute service till 10.20, and then reverts to a 20-minute service till midnight, with a 5-minute interval on Saturday and Sunday afternoons and holidays. An extension is now in course of construction along the shore of the bay to the other side, known as the Dover Road extension, with an ultimate view of continuing out to South Head.

Sydney Trams: Signal Posts.

The generators, two 150-kw. General Electric six-pole machines running at 400 revolutions, are driven from the cable engines at the Rushcutter Bay power house by means of counter-shafting and belting. A battery of 240R. 9 type Chloride cells is provided for use in case of stoppage of the cable line. These generators also supply power for an electric pumping station used in connection with the sewerage system, a description of which is given later. The switchboard is of standard General Electric pattern, with two generator panels, an accumulator panel, and two feeder panels.

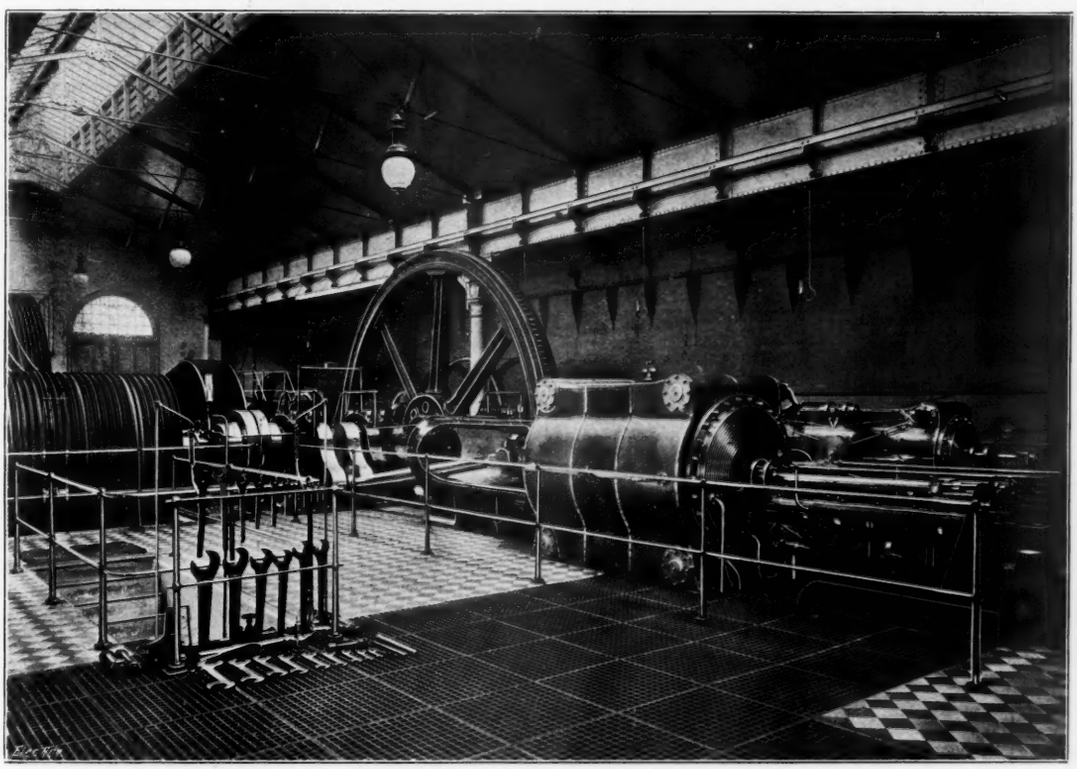
Poles at the side of the road with brackets are used for the overhead construction, with two overhead lines, one for

down cars and the other for up, the second overhead line being used instead of a feeder; the track is a single line with three turnouts. The feeder cables from the power house are of Callender's lock-coil type, laid direct under the footpath. The track is laid with 83-lb. rails bonded with plastic bonds. To complete the return to Rushcutter's Bay where the generators are situated, the two inner rails of the cable tramway are similarly bonded, and the whole length of the track cross-bonded every 80 yards with Bryan bonds. A test made after the track had been laid 10 months gave the resistance of rails from the end of the line to the power house, distant 1 mile 70 chains, as 0·058 ohm, the cable track being laid with 86-lb. rails. Some views on this line were shown in our issue of February 24th last. North Sydney, a thickly-populated suburb, or collection of suburbs on the north side of the harbour, is served by lines of ferry steamers running from the city to various points. From Milson's Point until recently a cable tram carried a large proportion of the traffic up the hill to Ridge Street, from which point the electric service commenced running to Gore Hill, Willoughby, Military Road, and Mosman's Bay, the latter line also running down to the harbour shores and picking up the passengers from another line of ferry steamers. Until lately all these North Shore lines have been supplied with power from generators driven by the cable engines, the power house being at Ridge Street, but recently the Milson's Point cable line has been converted to the electric system, and power is supplied for the whole of the North Sydney service from the new main power house at Ultimo by means of submarine feeders laid under the harbour from Dawes Point to Milson's Point. The North Sydney service is a heavy one, inasmuch as the ground rises steadily from the shores of the harbour until it reaches a height of about 300 feet at the terminus of the Gore Hill line, so that a heavy load comes on as each ferry steamer comes in and discharges its load of passengers. This applies equally to the Mosman's Bay and Neutral Bay line just completed. Overhead construction is used throughout, partly span wire and partly side poles with brackets. There are 7 miles 54 chains of line now opened for traffic at North Sydney, comprising 9 miles 66 chains of track:—

Milson's Point to Ridge Street (double)	...	1 mile	30 chains
Ridge Street to Middle Harbour (Spit Road)		2 miles	26 „
Spit Road to Mosman's Bay			64 „
Neutral Bay to Military Road			72 „
Ridge Street to Willoughby			72 „
Willoughby to Gore Hill		1 mile	30 „

The Military Road or Middle Harbour line, the first constructed on the North Shore, is single track, with 90-lb. steel rails with 35-lb. guard rails on ironbark sleepers 9 inches × 4½ inches and 8 inches long, laid on good ballast and spaced 2 feet 8 inches centre to centre, the gauge being 4 feet 8½ inches. The gradients are severe and numerous; from the power house to the terminus 52·6 per cent., and on the return journey 46·3 per cent. of the distance consists of rising grades, the total lift being 104 feet on the former and 91 feet on the latter; the level track throughout only amounts to 2 per cent. The steepest grade is 1 in 16·6 or 6·03 per cent. for a length of 198 feet, and is on a curve of 1,327 feet radius. The longest gradient is 1 in 28 for a length of 1,036 feet. There are 19 curves on the road, the sharpest having a radius of 103½ feet and an arc of 132 feet, while the flattest curve has a radius of 2,640 feet and the longest curve has an arc of 264 feet; at one portion of the road a reverse curve occurs of 132 feet radius, 165 feet arc with 66 feet of straight. Side pole construction with brackets is used throughout, except where the route is over a portion of the old cable line; here span wires are used, the poles being placed 120 feet apart on the straight. On the line from Milson's Point to about 20 chains beyond the old power house, which is all double track, span wires are used.

The Mosman's Bay line, though short, is very severe both in the way of curves and of grades, as the road rises all the way from the water's edge, and consequently there is a very small percentage of either level or straight road, the average grade throughout the line being 1 in 18 and the ruling grade 1 in 12, which is on a curve of 2½ chains radius; of the whole distance 25 chains are on a grade of 1 in 13 or over. The line is laid with 60-lb. Vignoles rails, bonded partly with Edison-Brown plastic bonds, and partly with a cable bond constructed of 19/14 copper cable, made solid at the ends, of semi-circular section, and expanded into the rail with a semi-circular tapering pin.

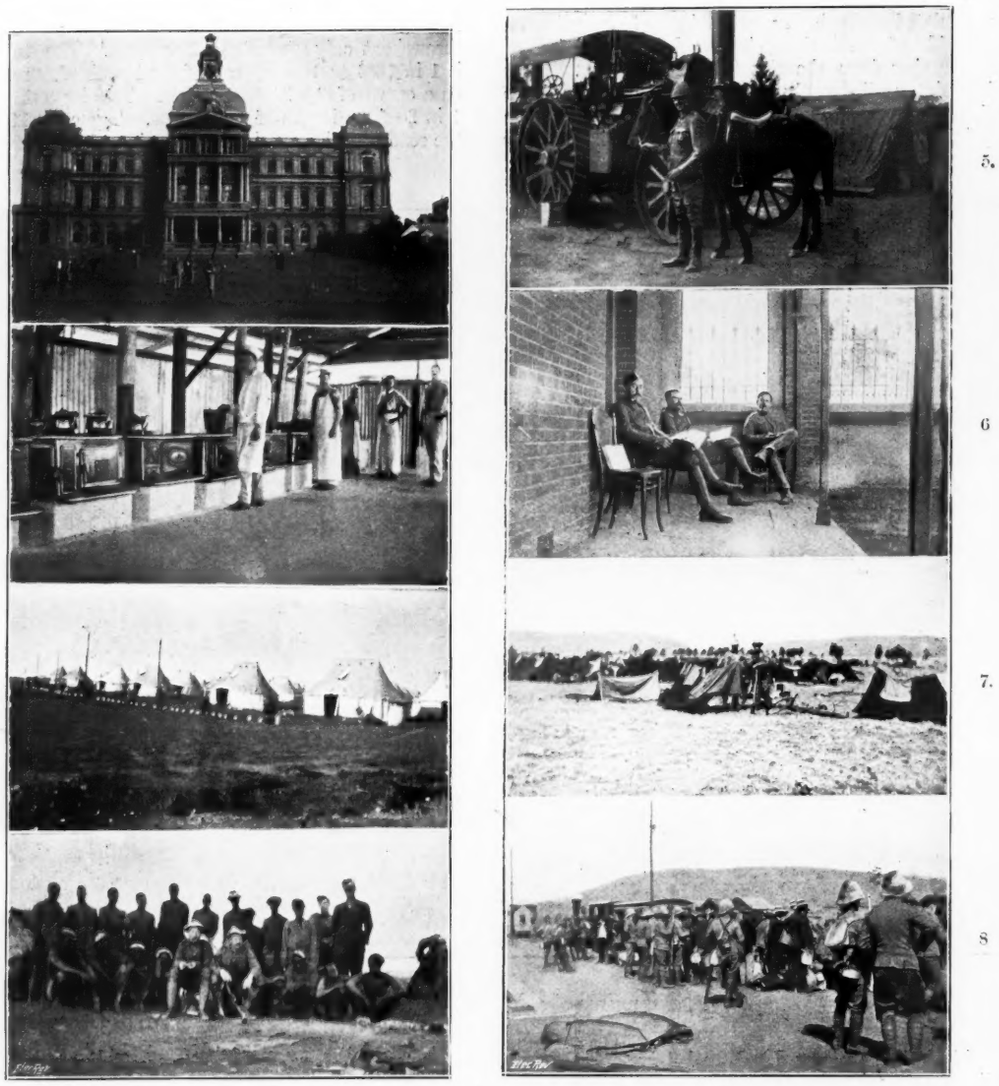


Sydney Trams: Power House, Rushcutter Bay.

The Willoughby section is laid with 60-lb. Vignoles rails bonded with plastic bonds, and the Gore Hill with 83-lb. rails, also bonded with Edison-Brown bonds. The Milson's Point section still has the old 42-lb. rails laid 14 years ago for the cable road, and is bonded temporarily with a cable bond, having an additional 19 14 cable laid as a return and cross bonded; it is intended to relay this permanent way shortly.

The old main switchboard at the Ridge Street power house is converted into a feeder board, a pair of main feeders of 500,000 circular mils section being laid direct from the Ultimo power house *viâ* George Street to Dawes Point, thence provided to prevent damage in case of the failure of the motor, blowing out of battery cut-outs, &c. The Willoughby feeder station is situated at the bottom of a dip about 73 chains from Ridge Street. The cells at Spit Road serve to assist the Mosman's Bay tram as well as the Spit Road and Military Road and Neutral Bay lines. A curve is attached showing the periods at which the battery is being charged and is discharging, and it shows very clearly the times at which the Mosman's Bay ferry boat comes in, the batteries giving their heaviest discharge to assist the cars in mounting the hill.

A further extension of the North Sydney system is now



1. Government Buildings, Pretoria.
2. Military Bakery at Pretoria, formerly a jam factory.
3. Langman Hospital.
4. E.E.'s and their Kaffir assistants.
5. Corporal Stone (now 2nd Lieut., R.F.A.).
6. E.E.'s in Pretoria Electricity Works.
7. The C.I.V. Camp at Pretoria.
8. Boers who plotted to assassinate Lord Roberts, under guard.

Electrical Engineers R.E. Volunteers.

by armoured submarine cable of Callender's make to Milson's Point, and from there overhead by "weatherproof" cables to Ridge Street. There are three battery stations, one at Ridge Street, comprising a set of R.9 Chloride cells, one at Spit Road, consisting of 215 K.19, E.P.S., and 20 R.9, Chloride cells, and one at Willoughby, of 238 Chloride cells. A new Tudor battery is now under order for Ridge Street, and should shortly be in place. At both the Spit Road and Willoughby feeder stations there are boosters, composed of a Parker motor running at 950 revolutions per minute, connected by means of a flexible coupling to a Parker series wound generator giving 100 amperes at 50 volts; automatic switching appliances are in progress from the Spit Road down to what is known as the Spit, from which a cable ferry runs across Middle Harbour and carries the vehicular traffic to Manly. It is probable that this will eventually be continued right on to Manly at an early date.

The total length of track on all the Sydney tramway systems consists at present of 39 miles 28 chains of double track and 17 miles 65 chains of single track. Of these 10 miles 54 chains of double track and 9 miles 15 chains of single track are now working electrically, and by the end of the year it is anticipated that there will be a further addition of 6 miles 56 chains of double track and 4 miles 61 chains of single track.

ELECTRIC TRACTION NOTES.

(*Continued from page* 784.)

Paisley. — A poll of the ratepayers took place on Saturday, 3rd inst., on the question of who was to work the new electric tramway system in Paisley. The question has been fought out with great bitterness by both parties. There are 13,081 voters on the municipal roll, and the figures were:—For a private company, 3,616; for a Corporation Bill, 2,022; majority, 1,594. Provost Mackenzie, who acted as returning officer, on announcing the figures, said that he was sorry that the general poll was small, but he was pleased that the ratepayers had given such an emphatic verdict on this important question. Everyone must now bow to their decision, and it would enable the Town Council to go forward with confidence and take united action in the matter. Mr. W. M. Murphy, of Dublin, is at present the only private party in the field with a tramway Bill. The Town Council are, however, considering the matter, and they may eventually lease the system to some of the firms with whom they have already had correspondence.

Scarborough.—A private company has intimated its intention to promote a £120,000 tramway scheme for the town.

Spen Valley.—The Light Railway Commissioners have submitted the Spen Valley Light Railway (Extensions) Order to the Board of Trade for confirmation.

Surbiton.—The U.D.C. on Monday decided to make a provisional agreement with the London United Tramways, Limited, and not to proceed with their own Tramway Bill. The company proposes to pay a wayleave of £300 yearly for five years, and £500 a year thereafter, to pay all the Council's Parliamentary costs, and to provide £500 to be spent by the Council for public improvements. The company also promises to run trams every four minutes, and to grant facilities for workmen's fares, &c., averaging ¼d. a mile. If the company fail to get powers for the adjoining Kingston district, they will connect the Surbiton system with the already sanctioned Middlesex system by way of Hampton Court Bridge. Negotiations had also been entered into by the Council with the Kingston Corporation; the latter could not offer an annual wayleave nor a contribution for public improvements, but they offered a share of the profits of the line when constructed. Mr. Engelbach, a member of the Council, reported that he had, on his own initiative, taken a postcard poll of the ratepayers with the following result:—Against tramways, 726; in favour of tramways, 615; neutral, 69, unsigned, 53, forgeries, 84.

West Bromwich.—At the meeting of the Town Council last week the General Purposes Committee reported that they had now arranged terms with the South Staffordshire Tramways (Lessee) Company, by which the tramways, when acquired by the Corporation, should be leased to the company on specified terms. These terms have already appeared in the ELECTRICAL REVIEW. The Mayor intimated that the Corporation intended to obtain possession of the tramways as early as possible.

Wimbledon.—At the meeting of the U.D.C. on Wednesday it was decided to promote an Improvement Bill in Parliament for a number of objects, including the construction, working, and leasing of about four furlongs of electrical tramways from Wimbledon railway station to the Tooting boundary, at a total estimated cost of £28,000. Mr. R. S. Bond said that the L.C.C. and the Croydon and Merton authorities would assist Wimbledon in their scheme. This line, if constructed, will approach within 15 furlongs of the intended extension of the L.C.C. system to Tooting, and the desirability of constructing a connecting link has been already discussed by the L.C.C., the Finance Committee of which reported that the estimated cost of the link would be £39,250. The L.C.C. Committee added the following to their report:—

> The annual charge for interest and repayment of capital would be £2,580. We are unable to go into the question of the probable financial results of this extension without further information, but it appears to us that except as a connecting link with the proposed Wimbledon tramways, the Council could not, on financial grounds, be recommended to construct it. We presume, therefore, that it would only be carried out in the event of the Wimbledon scheme being proceeded with.

Willenhall.—At the meeting of the Urban District Council on Monday, Mr. T. Hulse drew the attention of the members to the case pending between the Wolverhampton Corporation and the British Electric Traction Company. He moved that the clerk be instructed to write the British Electric Traction Company, offering to render them what assistance they could. The people thought that the Council should have supported Wolverhampton, and not have come to terms with the Traction Company. Wolverhampton Corporation refused, however, to offer any terms, and they wanted Willenhall to buy the Willenhall section of the trams from the tramway company, and then sell to them at no advance whatever. Mr. Hulse thought that the best interests of the town had been served by coming to terms with the British Electric Traction Company, who had offered to extend the tramlines to Walsall Road Schools, and to connect Willenhall with Bilston, Wednesbury, and Darlaston. Mr. J. H. James seconded the resolution. Wolverhampton, he remarked, had laid the blame upon Willenhall, but the cause of the disconnected service lay with Wolverhampton. Two deputations from that Council had waited upon the Wolverhampton Corporation, and were most anxious to come to terms, but could get nothing, not even the promise of an improved service. He said that the best interests of the town were being served, and that no effort would be spared to secure a better service and a permanent benefit to the town. The resolution was carried unanimously.

TELEGRAPH AND TELEPHONE NOTES.

Brighton Telephones. — The Telephone Committee has reported to the T.C. that a letter had been received from Mr. A. R. Bennett, of Glasgow, stating that his usual arrangement with Corporations was to act as consulting engineer for the telephone system on a commission of 5 per cent. on the actual capital outlay, and his out-of-pocket expenses, but no commission to be paid on any excess expenditure over the estimates. He kept an eye on the work during construction, and provided samples of the forms and books necessary for starting a telephone exchange business, and keeping telephone accounts. He also advised as to the appointment of a competent manager and other officials, and, in fact, did whatever was within his experience as a telephone manager and engineer to make the undertaking a success. If the Telephone Committee simply asked for the preparation of a scheme, with estimate, for the establishment of a 2,000-line municipal telephone exchange system in the Brighton area, his charge would be 50 guineas and out-of-pocket expenses, but the 50 guineas would be merged into the commission should the scheme be proceeded with under his care on the terms set forth above. Mr. Bennett's offer to prepare a scheme and estimate for 50 guineas was accepted. A letter had been received from the town clerk of Hove stating the Council thought it expedient to formally notify to the Postmaster-General that they objected to the application; but since then they had given the matter their consideration and had been advised on it, and as a result they had instructed him to inform the Postmaster-General that they did not propose to offer further opposition to the application. This only affected the bare question of including the borough of Hove in the proposed area, and left all questions of interference with the streets and other property in the borough a matter for further consideration.

Hartlepool Telephones.—The Finance Committee of West Hartlepool Corporation have engaged the services of an expert to report upon the desirability and cost of installing a municipal telephone service in the town. Similar action is likely to be taken in Hartlepool.

The Telegraph Wire Export Trade.—Although better than September, last month proved to be relatively a quiet one as regards the exports from this country of telegraph wire and apparatus connected therewith. The value of the October shipments is returned at £114,253, as compared with £80,248 in September last, and £369,243 in October, 1899. Taking the 10 months ending with October last, the year, has, however, been an unusually active one, the aggregate shipments having attained a value of no less than £2,583,729, as contrasted with only £1,100,580 in the corresponding period of 1899, and £936,721 in the first 10 months of 1898.

Telegraph Rates to India.—Sir Edward Sassoon has sent to the *Times* (November 14th) a copy of correspondence which has passed between himself and Lord George Hamilton during the past six weeks. Sir Edward says that although five months ago, Mr. Hanbury announced that the 1s. 6d. reduction on India cable rates was on the point of coming into force, the matter still appeared to hang fire, and he suggested that it was urgently necessary that this reduction should be no longer delayed. He earnestly urged "the bringing into force of the 2s. 6d. rate as soon as may be, with the understanding that the question of an ultimate reduction will be taken up and deliberated on at leisure." In reply to this, Lord George Hamilton forwarded a copy of a memorandum which had been drawn up, giving "a succinct and intelligent account of the obstacles to be overcome before the rates between India and Europe can be cheapened." This memorandum is printed along with the correspondence. In Sir Edward's remarks to the *Times*, he observes that it seems passing strange that while substantial reductions have been successfully effected upon trans-Indian messages to Australia and the Far East, the high rate to India must remain unchanged owing to the apparently insuperable barrier presented by the necessity of gaining the assent of Russia and Germany." Again, he says, "It will be an unpleasant surprise to many to discover to what an extent the business community of the Empire has been rendered subservient to the good will and pleasure of foreign Governments and private companies, and how the Indian Government Telegraph Department officials have allowed themselves to fall blindly into such a position that they have to surrender any right to advance the interests of the public, whose servants they are." . . . . The telegraph convention "appears to be a convenient shield behind which the companies protect themselves from competition, while, on the other hand, they themselves disregard its provisions by entering into private bargains with the Governments concerned, as is shown in the memorandum. The only means of emancipating ourselves from this mediæval thraldom would seem to be by starting an independent land and cable route, apart from the territories and lines of the Governments and companies at present interested. Some such scheme, feasible in character, and which may be expeditiously carried out at a comparatively modest cost, I hope to have the honour of laying before the Departmental Committee and

at 50 volts; automatic switching appliances are of single track.

the Indian Government. The consent and close co-operation of the latter would, of course, be indispensable to the launching of such an enterprise."

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
African:—		
St. Louis (Senegal)-Bathurst	Aug. 25, 1900	
St. Louis (Senegal)-Teneriffe	Nov. 11, 1900	
Zanzibar-Mombassa	Sept. 29, 1900	
Zanzibar-Aden	Nov. 9, 1900	
South American:—		
Pará-Maranham	March 1, 1900	
Ceará-Maranhám	Feb. 20, 1900	Nov. 13, 1900
Paramaribo-Cayenne	Oct. 6, 1900	
Barcelona - Guanta - Cumana - Portlamar - Carupano (Venezuela)	Nov. 1, 1900	
West Indian:—		
Mole St. Nicholas-Cape Haitien	March 6, 1900	Nov. 13, 1900
Havre-Waterville	Nov. 8, 1900	
Latakia-Cyprus	June 20, 1899.	
Landlines:—		
African:—		
Mujunga-Tananarive	Nov. 6, 1900	
Chinese:—		
Tientsin-Pekin	June 12, 1900	
Pekin-Kalgan	June 14, 1900	
Kalgan-Maimatchin	June 30, 1900	
Tientsin, *via* Shanghai	June 16, 1900	
Tientsin-Niuchwang	June 18, 1900	
South American:—		
Communications with all offices of Colombia beyond Buenaventura	January 23, 1900	
Ecuador landlines	March 13, 1897	
Landlines south of Serena	July 30, 1900	
Landlines west of Barquisineto and Coro	Nov. 1, 1900	
Barcelona (Venezuela)-Ciudad (Bolivar)	Nov. 1, 1900	
West Indian:—		
Landline to Baracoa, Guantago and Sagua de Tanamo	Nov. 12, 1600	
All lines connecting Cochin China with Thuanan	Oct. 23, 1900	
Blagowestschensk-Chabarovsk	Nov. 7, 1900	Nov. 9, 1900.
Communications between Saigon and North Annam and Tonkin	Oct. 23, 1900	
Communication "*via* Hanekine" interrupted on Persian territory	Feb. 24, 1900	

Wireless Telegraphy.—Russia is taking up the question of wireless telegraphy with remarkable energy, and the successful results of the Popoff system have induced the Minister of Marine to further extend its use. Only last week (says a *Daily Mail* message from St. Petersburg) 200 complete pieces of apparatus were shipped to Vladivostok and Port Arthur in order to fit out the Russian warships in the Pacific with wireless telegraphy, and further, to connect the two towns mentioned by means of stations along the Korean coast.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belfast.—November 23rd. Tenders are invited for steam pipes, pumps, condensing plant, boilers, mechanical stokers, superheaters, coal and ash conveying plant, and switchboard extensions for the Corporation electricity works. See "Official Notices" October 12th.

Bermondsey.—December 3rd. The Vestry invites tenders for 71 cast-iron arc lamp columns, arc and incandescent lamps, automatic switches and fittings. See "Official Notices" to-day.

Brighton.—December 6th. The Council invites tenders for points, crossings, sole-plates, manhole covers and gulley-grates, tie-bars, fish-bolts, &c., for the electric tramways. See "Official Notices" to-day.

Brighton.—December 13th. The Council wants tenders for the construction of permanent way including bonding, &c.; paving all tramway tracks with wood, &c. See "Official Notices" to-day.

Bristol.—November 22nd. The Electrical Committee wants tenders for an electric travelling crane and condensing plant. See "Official Notices" November 9th.

Cardiff.—November 28th. The Corporation wants tenders for a 75-KW. motor generator, Tudor battery, lead covered cables, and a 20-ton travelling crane for the tramways undertaking. See "Official Notices" November 9th.

Greenwich.—November 22nd. The Guardians want tenders for the electric lighting of the new workhouse now erecting. See "Official Notices" November 2nd.

Halifax.—The Tramways and Electricity Committee wants tenders for various sized underground cables. See "Official Notices" November 2nd.

Halifax.—November 27th. The Tramways Committee invites tenders for the supply of 36 tramcars, trucks, motors, and electrical equipments for same. See "Official Notices."

Harwich.—November 17th. Tenders are being invited for gas engines, dynamos, cables, battery, lighting and traction switchboard, track laying, and traction equipment, &c. See "Official Notices" November 2nd.

Hendon.—December 31st. The U.D.C. wants tenders for Lancashire boilers, stokers, pumps and economiser; two 150-KW. steam dynamos, motor transformer, &c.; condensing plant, crane, switchboard work, battery, mains, meters, and workshop equipment for electricity works. See "Official Notices" to-day.

Kendal.—November 25th. The Corporation wants tenders for complete electric lighting station equipment (boilers, steam dynamos, battery, &c.); and for underground mains, meters and services. See "Official Notices" November 2nd.

London.—November 22nd. Tenders are invited for the wiring of the Central Finsbury Radical Club. See "Official Notices" November 9th.

Newcastle-on-Tyne.—November 21st. The New Tramways Committee wants tenders for arc lamp cables, telephone and pilot wires. Specifications from Mr. Charles Hopkinson, consulting engineer, 26, Victoria Street, S.W.

Oldham.—November 27th. The Electricity Committee wants tenders for an extension switchboard for supplying current to the tramways. See "Official Notices" to-day.

Shoreditch.—November 20th. The Vestry is inviting tenders for various steam raising and electric generating plant for the new station, of which particulars were given in our "Official Notices" November 9th.

Stavanger.—January 2nd. Tenders are invited by the Stavanger Corporation for the establishment of electrical communication or transmission of power from the Altesrig Waterfalls to Stavanger, a distance of about 39 kilometres, in accordance with the plans of a civil engineer named Schoien. Tenders must be received by January 2nd, 1901. Further information may be obtained on application direct to Mr. E. Berentsen, British Vice-Consul, Stavanger.

Stockport.—November 24th. The T.C. wants tenders for the laying of permanent way for electric tramways. Also for the supply of 1,050 tons of girder rails, 90 tons of fishplates, 25 tons of tie bars, various points, crossings, bolts and nuts, &c. See two "Official Notices" November 9th.

Stockport.—November 24th. The T.C. wants tenders for the overhead equipment, and supply of rail bonds, for six sections of electric tramways. See "Official Notices" November 9th.

West Bromwich.—November 17th. The Corporation wants tenders for wiring materials, motors, and labour in wiring for lighting and power installations. See "Official Notices" November 9th.

CLOSED.

Aberdeen.—The Tramways Committee is ordering 12 electrical cars and a number of equipments for existing horse cars from the British Westinghouse Company.

Liège.—Tenders were opened last week by the municipal authorities of Liège for the supply of 20 trailing cars for the electric tramways in that city. Ten tenders were received, of which no less than seven emanated from German firms. The lowest offer was that of the Gotha Wagon Works Company, of Gotha, Germany, who quoted 3,062½ francs per car. No English firm competed.

Worthing.—On the report of Messrs. Burstall & Monkhouse, the E.L. Committee has accepted the tender of Messrs. Oliver & Co. for arc lamps, at £850 17s.

FORTHCOMING EVENTS.

Friday, November 16th.—At 7.30 p.m. North-East Coast Institution of Engineers and Shipbuilders, second general meeting at Sunderland, paper on "Liquid Fuel," by E. L. Orde.

At 8 p.m.—Institution of Mechanical Engineers. Ordinary meeting at Storey's Gate, S.W., paper on the "Capacity of Railway Wagons, as affecting Cost of Transport," by J. D. Twinberrow.

At 8 p.m.—Electro-Harmonic Society. Concert at the St. James's Hall Restaurant, Regent Street.

Wednesday, November 21st.—At 8 p.m. Society of Arts. First ordinary meeting; opening address by Sir John Evans, F.R.S.

Thursday, November 22nd.—At 8 p.m. Institution of Electrical Engineers. "Telegraphs and Telephones at the Paris Exhibition, 1900," by John Gavey, member.

Friday, November 23rd.—At 5 p.m. Physical Society. Agenda: (1) "The Anomalous Dispersion of Carbon," by Prof. R. W. Wood; (2) "The Liquefaction of Hydrogen," by Mr. M. W. Travers; (3) "On the Refraction of Sound by Wind," by Dr. E. H. Barton.

At 7.30 p.m.—Institution of Junior Engineers. Joint meeting with the Architectural Association at 9, Conduit Street, W. Paper on "The Use of Rolled Joists in Construction," by Mr. A. T. Walmisley, M.I.E.E.

Thursday, November 29th.—Extra meeting of the Institution of Electrical Engineers, in the rooms of the Institution of Mechanical Engineers. Paper by Mr. W. E. Langdon, on "The Supersession of the Steam by the Electric Locomotive."

NOTES.

The Proposed Electrical Contractors' Association.—We have received several further communications relating to the above matter, and we shall be glad to receive others from those whose interests are affected. We may make a selection from these for publication in our next or a subsequent issue.

Unregistered Patent Agents.—In a letter which appeared in the *Times* of October 18th, it was pointed out that an individual who had received fees in respect of no less than 553 inventions had confessed to misapplying the money. His *modus operandi* was to correspond with American inventors and then obtain remittances from them for the purpose of obtaining British protection. In spite of this fraudulent dealing he is still recognised at the Patent Office, and continues to practice as a patent agent, the absence of his name from the register of patent agents affording him protection against the officials of the Patent Office. We have here another instance of the very limited jurisdiction which the recognised members of a great profession can exercise over those who fraudulently encroach upon their hunting grounds. In the medical profession the doctors have no jurisdiction over quacks, unless they hold themselves out as entitled to use certain titles implying that they are registered. The same principle applies to patent agents. Thus the Patent Act, 1885, Sec. 1, (1) provides for the registration of patent agents, and under that Act no person is entitled to describe himself as a patent agent, whether by advertisement, by description on his place of business, by any document issued by him, or otherwise, unless he is registered under the Act. Any person who knowingly describes himself as a patent agent, without being registered, is liable, on summary conviction, to a fine not exceeding £20. These provisions would seem, at first sight, to afford sufficient protection against unregistered patent agents. Acting, however, upon the same principles which are applied in the case of quack doctors, the Courts have refused to convict, unless they are satisfied that the accused has actually held himself out as a patent agent. Thus the use of the term "patent expert" by an unregistered person has been held not to amount to this offence. [Graham *v.* Eli, 15 R.P.C. 259.] But an agent practising *bonâ fide* prior to the passing of the Act is entitled to be registered in the ordinary way. (Patents Act, 1888, Sec. 1, (3)). The difficulty in these cases is to devise some means whereby the offending party can be "got at." The Patent Office Library is open to all; an unauthorised agent can give advice to clients with perfect safety in the recesses of his office; but where, as in the case mentioned by the *Times* correspondent, the gentleman in question is "recognised" by the Patent Office, there surely ought to be some means devised whereby the public could be safeguarded from any repetition of his fraud.

Royal Society.—Among the papers down for reading yesterday was "Argon and its Companions," by Prof. Ramsay, F.R.S., and Dr. Travers.

The Pacific Cable.—We drew attention last week to Sir J. Wolfe Barry's remarks to the meeting of the Eastern Extension Telegraph Company regarding the contracts for this cable. Upon further consideration, we are inclined to the belief that the matter has not yet been decided. It seems but within the bounds of reason that the announcement would be made in London if it were so. There appears to us to be an "internal contradiction" in what Sir J. Wolfe Barry says, for he mentions a ship, stations, &c., whereas the tenders were for cable *only*, neither instruments, station houses, repairing ships, or anything of that sort being asked for. A tender for the use of a vessel fitted to supplement the present sounding lines was asked for, but that was the only thing outside the *cable* pure and simple. Also it seems to us that the amount of the tenders exceeds the anticipated sum, and therefore the money voted by the Colonies is insufficient. This calls for a supplementary vote, so that the matter is incomplete as yet. The statements which have been circulated up to the present appear to be little, if anything, more than mere rumours. The *Sydney Morning Herald* for September 26th contained the following paragraph, which lends authority to our opinion:—

Melbourne, Tuesday.

Neither the Premier nor the Postmaster-General has received any message from the Imperial authorities confirming the information received by the Queensland Government to the effect that a tender has been accepted for laying the Pacific cable. The Premier thinks it strange that the Imperial authorities should accept a tender before consulting with the contracting Colonies.

The same paper also published the following:—

Pacific Cable.—The Postmaster-General stated that he had no new information to give last night regarding the proposed Pacific cable. He gave notice, however, that he would move to-day in the Legislative Assembly:—"That this House will, on its next sitting day, resolve itself into a committee of the whole to consider the expediency of bringing in a Bill to enable the Government of New South Wales to join with certain other Governments in the cost of construction and maintenance of a cable across the Pacific Ocean, and for purposes consequent upon and incidental to such object."

How a light at Pipon Island came to be mixed up with the Pacific cable, we fail to understand, but the following note from the *Sydney Daily Telegraph* for September 27th will serve to show how the confusionists are at work:—

NOT THE PACIFIC CABLE.

Tender for a Lighthouse.

Brisbane, Wednesday.—The Government has received a further cablegram from the Agent-General elucidating the previous cablegram which had announced the acceptance of a tender for the Pacific cable. It has transpired that there was an error as to the tender. The *one accepted was* for the erection of a light at Pipon Island.

Obituary.—It is with unfeigned regret that we have to announce the death, on the 9th inst., after a very few weeks' illness, of Mr. E. Davis, the founder of the company of Davis & Timmins, Limited. We remember the business as far back as 1879, when it was established in Bowling Green Lane, Farringdon Road, and ever since have held its managing director, now deceased, in the greatest respect. The funeral took place at St. Mary's Catholic Cemetery, Kensal Green, on Tuesday last, when the departed was borne to rest, surrounded by many friends who in life had the pleasure of knowing him. Of the workpeople, nearly all of whom were present at the ceremony, and who exhibited a great deal of genuine feeling, many had commenced as boys and had grown up to manhood in his employ. Handsome wreaths were laid upon the coffin, the workpeople contributing some very beautiful tokens of their affection for one who had ever been a friend to them.

We regret to learn of the death on November 7th of Herr Johannes Hausmann, engineer-in-chief to the well-known firm of Felten & Guilleaume, of Mulheim am Rhein. After 25 years' active life in connection with the electrical industry, he was about to enter into a well-earned retirement. It was willed otherwise, however.

Will.—It is stated in the daily press that the estate has been valued at £114,710 17s. 8d. gross and at £109,993 12s. 8d. net of Mr. John Robert Jefferies, of St. Helen's Lodge, Ipswich, and of Ransomes, Sims & Jefferies, Limited.

Electrical Engineering at the Paris Exhibition.—Prof. Ripper, M.I.C.E., delivered the opening lecture to the Sheffield Society of Engineers and Metallurgists on Monday, dealing chiefly with engineering at the Paris Exhibition. In referring to the great strides electricity had taken during recent years, he pointed out that all the power required in the Exhibition was electrical, every conceivable machine and appliance requiring movement being driven by electric motor receiving current from the central supply. He was much struck with the size and weight of the engines compared with the power produced, and it was a relief to him to turn from these massive Continental engines to look at the small Willans in the small British section. Here was an engine whose power was at least equal to any engine in the Exhibition, weighing about one-third that of its Continental rivals, and occupying about one-fourth of the floor space of the horizontal engines. With regard to the size of the units at the Exhibition, compared with our own British practice, the problem of electrical power generation has been solved somewhat differently in this country. If there were to be a great electrical exhibition in England at the present time, giving the same total electrical output as at Paris, and if it were made to illustrate current practice during the last few years, we should have gathered together the finest collection the world has ever seen of high-speed engines, that is, high revolution engines, whose power would be great, but whose weight would be about one-third, and floor space one-fourth of that of the large horizontal slow-speed type, which appeared to be most universal throughout the Continent. The small high-speed engines had suited the conditions which it had to meet in this country, especially the cost per square yard of floor area, and the type of engine reflected the conditions which had been demanded of it, namely, large power in small space. On the Continent, the question of space occupied by an engine appeared to be of secondary consideration. A further reason for the large unit of power on the Continent was the fact that the average area over which the electrical energy was supplied was much larger on the Continent than had hitherto been the case in this country, but there was no doubt that with the rapidly growing demand for electricity over extended areas in this country, much larger units would be introduced. Already this demand was being anticipated among mill engine builders, and even by some of our marine engine builders, who were now extending their business to include electric central station work. It would not be found necessary, he thought, in future to go to America or any other country to supply central station engines, as was the case a short time ago. The quick revolution engine makers were also now making engines in much larger sizes than was previously the case.

Personal.—We are informed that the Council of the Tramways and Light Railways Association have appointed Mr. Norman Thompson, B.A. (Cantab), A.I.E.E., as secretary of the Association, and that his offices are at Clun House, Surrey Street, Strand.

Mr. Harold Firth, of Shipley, has been appointed head of the Electric Lighting Department of the Great Eastern Railway, Liverpool Street, London.

The Postmaster-General has appointed Mr. Thomas Mason, the chief superintendent of the Special Telegraph Arrangements Branch, to be traffic manager for telegraph business in the United Kingdom. This is an entirely new departmental post.

Corporal Douglas F. Colson, R.E. Electrical Engineers Volunteer Corps, who is the son of Mr. Alfred Colson, engineer-manager of the Corporation gas and electricity department, received a hearty home welcoming from the people of Leicester on Tuesday last week. Corporal Colson was taken prisoner at Leewspruit in June last, and was subsequently released and put over the Natal border. He sustained injuries to his right hand, followed by blood poisoning, and was invalided home from Pietermaritzburg. He was received at Leicester station by many of the officials and men of the gas and electricity works.

Mr. J. C. Steele, late of Sunderland, and Mr. C. Follenfant, of Bradford, have been appointed to the posts of assistant engineers in West Hartlepool. There were 60 applications in all.

Supply Station Accidents.—This week there have occurred three more fatalities in connection with public electricity works. At Newport (Mon.) an assistant engineer met his death from shock while performing switchboard duties, and at a Cheltenham sub-station a fitter was killed on Tuesday while making a joint.

As we go to press a report comes to hand of yet another accident. The victim in this case was an assistant engineer at the Metropolitan Electric Supply Company's station at South Street, Marylebone. He died from the effects of a shock received on Tuesday morning whilst making connections at the switchboard. The verdict declared by the jury at the inquest held yesterday (Thursday) was as follows:—Deceased died from the effects of electric shock through his hands coming in contact with the electric current of a switch when he was changing the current. Death was due to accidental causes. The jury would recommend to the immediate consideration of the company the necessity of protecting the metal switches in such a manner that a similar occurrence could not happen again.

We shall refer to these fatalities at greater length next week.

Institution of Electrical Engineers.—The following is a list of the meetings arranged by the Manchester section of the Institution, to be held at the New Physical Laboratory, Owens College.

November 13th.—At 7.30 p.m. Prof. Arthur Schuster, F.R.S. "Some Phenomena of Electric Sparks. (Illustrated by experiments.)
November 27th.—Hardman A. Earle, M.I.C.E., M.I.E.E. "Relative Advantages of Direct-current and Three-phase Distribution for Small Installations."
December 11th.—F. B. Behr. "Proposed Manchester and Liverpool Express Railway." (Lantern slide illustrations.)
January 29th, 1901.—Sidney H. Short. "Direct-current Generators."
February 12th.—Dr. John T. Nicolson. "The Training of Electrical Engineers."
February 26th.—G. A. Grindle, M.I.E.E. "The Use of Storage Batteries in Connection with Electric Tramways."
March 12th.—John S. Raworth, M.I.C.E., M.I.E.E. "The Adaptation of the Steam Engine to the Generation of Electrical Energy."

We are informed by the secretary that an extra meeting of the Institution will be held in London, by kind permission, in the rooms of the Institution of Mechanical Engineers, at 8 p.m., on Thursday, November 29th, when a paper will be read by Mr. W. E. Langdon, vice-president, on "The Supersession of the Steam by the Electric Locomotive."

The Newcastle section of the Institution held its first annual dinner at the County Hotel on 7th inst., Mr. A. W. Heavisidc, presiding over a company of 60 members. Among the toasts was "The Newcastle Local Section," this being proposed by Prof. John Perry, F.R.S., and acknowledged by the chairman in an address covering numerous topics relating to the electrical profession and industry.

Electrically-Driven Fans in the U.S. Navy.—The *Globe* Naval correspondent says that in the report of the U.S. Naval Constructor, Mr. W. Capps, on the battleship *Alabama*, as compared with the *Kearsage*, the author advises the use of electrically-driven fans for ventilation. The ventilation of the *Kearsage* is said to be much more satisfactory than that of the *Alabama*, this condition being attributed largely to the use of electric fans in the *Kearsage*. The report says there can be no possible question as to the results obtained in the two vessels, and as the vessel ventilated by electrically-driven fans proved itself so much more satisfactory, it is strongly recommended that electrically-driven be substituted for steam-driven fans in the future.

Building Trades' Gift to the Nation.—The chairman of the Building Trades' Gift (homes for disabled soldiers) announces the receipt of a number of valuable contributions in money, collected primarily in the provinces. Among these contributions are:—£500 from the Birmingham Master Builders' Association; £200 from the Building Trades of Walsall; £65 from the Manchester Master Builders' Association; £47 from the Nottingham Master Builders' Association. Of recent London contributions, Messrs. Holloway Bros. have presented 50 guineas, while their workmen have collected 25 guineas, and Messrs. Perry & Co.'s workmen have sent 33 guineas. All the above contributions, it will be observed, are the result of a close co-operation between the masters, manufacturers, and men of the trades concerned.

110 v. 220-Volt Supply.—A very interesting communication from Mr. Horace Boot will be found in our "Correspondence" columns this week, giving the comparative charges before and after the change-over from 110 to 220 volts. Particulars are not given as to the number of lamps installed in each case, and this may have been altered during the periods considered; any change, however, would most likely be an increase. Nevertheless, on adding up the respective amounts, we find that the total units consumed in one year are:—At 110 volts, 28,579; at 220 volts, 28,034. What is still more surprising is the fact that the total revenue in the first instance was £761 6s. 10d.; in the second, £652 8s. 8d.—a reduction of no less than £108 18s. 2d., or over 14 per cent.! Surely this constitutes a new and powerful argument to induce consumers to accept the change. We should be very glad if Mr. Boot would kindly supplement his valuable contribution by a few particulars as to the system and rate of charging in the two cases, and, if possible, as to the corresponding cost of the supply.

British v. American Manufacturers.—A correspondent signing himself "South Africa" writes to the *Times* as follows:—"I can give you another illustration of the way in which the indifference of the British manufacturer drives trade into foreign hands. I recently applied to a maker in London for quotation for some thousands of wood boxes, specifying the size, and the nature and weight of the contents they were to carry. The British manufacturer asked for particulars as to the thickness of the wood and declined to quote without this information. While obtaining the necessary details from abroad, I at the same time sent the inquiry to America, and received a reply by return mail, quoting prices for boxes and estimated strength to carry the contents specified, although stating that the thickness should have been given. The result is that America will probably get the order. I see the two rivals sitting side by side at a dinner table. The Yankee at once 'goes for' the repast and satisfies his needs. The Britisher finds himself short of a knife or a spoon, calls for the missing article, and will not commence his meal until he gets it, and when at last it comes the dinner is all consumed. Surely the British manufacturer must be losing his appetite for trade."

Prof. Forbes and Niagara.—The Master Electrical Contractors' Association, of Dublin, were entertained by Prof. Geo. Forbes last week with an account of the Niagara Falls electrical utilisation. The scheme, and the power station equipment, were described, and the effects of the undertaking in the enormous development of electrical industries, and in other ways, were mentioned. The lecturer added that the century now closing had been described as the age of steam and steel; that about to dawn would be known as the age of aluminium and electricity. At the conclusion of the lecture the Lord Mayor made some comments upon the Dublin Corporation electricity scheme. He remarked that on Monday, November 12th, the Corporation would accept a contract for laying cables over the whole city at a cost of £113,000, and the electric lighting of Dublin would be completed in 12 months.

Correction.—The article on "The Growth of Polyphase Systems," printed in our issue of November 2nd, contained certain statistics regarding German installations; these we inadvertently omitted to mention first appeared in article form in the well-known *Elektrotechnische Zeitschrift* of Berlin, a translation appearing in one of our engineering exchanges. Those of our readers who wish to go further into the subject should refer to the issue of that journal for July 5th last.

The State of the Steel Industry.—It is stated that the Welsh steel manufacturers and workmen's representatives have jointly agreed to discontinue the payment of 10 per cent. advance on standard wages rate conceded recently. The trade is in a most unsatisfactory state, and several steel works have stopped. It is said that the reason of this state of affairs is, that American bars are being imported at ruinously low prices.

Society of Arts.—The arrangements for the forthcoming session include the following:—November 21st: Sir John Evans's opening address. December 5th: Prof. H. S. Hele-Shaw on "Road Traction." We have already mentioned Prof. Fleming's series of four Cantor lectures on "Electric Oscillations and Electric Waves," commencing on Monday, November 26th. After Christmas there will be a paper by Mr. F. B. Behr on "The proposed high-speed electrical 'Monorail' between Liverpool and Manchester;" Mr. Alexander Siemens on "Patent Law Reform." In March (11th, 18th and 25th) there will be a course of three lectures by Major P. Cardew on "Electric Railways." "Alloys" will form the subject of four lectures by Sir W. C. Roberts-Austen on April 22nd and 29th and May 6th and 13th.

Electrical Development in Japan.—The *Times* correspondent at Vienna has just been delving into Austrian official data regarding the economic condition of Japan. From his observations we gather that the water-power available for utilisation in connection with electrical engineering schemes is almost as extensive as the water-power of Norway. The iron and electrical industries are stated to be undergoing very vigorous development. This we have understood for some time past, but it is a revelation to us to learn that "Japan already possesses nearly 400 electric power works," and that "the electric light has been introduced into almost all the important towns." There are further stated to be some 20 electric tramway lines now working, while new ones are constantly being projected, and many are at present in course of construction. What meaning the writer wishes to convey when he refers to "electric power works" we do not know, but if there are 400 electric power works of any kind in Japan, electrical development there has been proceeding at a far greater pace than we imagined. Certainly it is a remarkable record for "beginners," as the writer terms the Japs. We are inclined to believe that there is an error in the figures.

Belleville Boilers.—H.M.S. *Hermes*, new cruiser, which has only been employed on the North American station for 12 months, has been ordered home to pay off in consequence of the state of her Belleville boilers. Her deck is said to be lined with defective boiler tubes.

Otium cum Dignitate.—One of our views of the E.E. Vols. this week conveys the impression that some of them were taking a well-earned rest. It is, of course, absurd to suppose that either in South Africa, or in this country, is such a thing as a cigarette or a shilling shocker so much as thought of during business hours in an electricity works.

Appointments Vacant.—A mains superintendent is wanted at £100 per annum by the Scarborough Electric Supply Company, Limited. A cable jointer is wanted at West Ham. See "Official Notices" this week.

Lecture.—On 6th inst. Mr. J. Brown delivered an address to the Belfast Natural History and Philosophical Society on "Some Matters Electric."

NEW COMPANIES REGISTERED.

Electric Lighting Boards (British Manufacturing Company), Limited (67,722).—This company was registered on November 8th, with a capital of £75,000 in £1 shares, to adopt an agreement with the Electric Lighting Boards, Limited, to acquire the benefit of certain existing inventions relating to luminous advertisements and electric lighting boards, and to manufacture and deal in the articles which can be manufactured and dealt with in connection therewith. The first subscribers (each with one share) are:—W. G. Gadsden, Lyveden Road, Tooting, S.W., gentleman; A. Tibbits, 19, Gordon Street, W.C., solicitor; H. L. Pring, 34, Cambrian Road, Richmond, accountant; W. Brittain, Pinner Wood, Pinner, solicitor; J. W. Stickland, Christwell, 19, Riggindale Road, Streatham, S.W., solicitor; E. Newroy, 21, Fitzroy Square, W., accountant; and A. H. Lister, 38, Tavistock Road, W., architect. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £100; remuneration, £100 each per annum (£150 for the chairman) and a share in the profits.

men of the trades concerned.

Founders' Syndicate, Limited (67,664).—This company was registered on November 5th, with a capital of £60,000 in £10 shares, to construct and equip electric tramways and railways, to build, manufacture, and deal with steamboats, launches, carriages, vans, cycles, velocipedes, motor cars, flying machines and vehicles, and to carry on the business of electricians, electrical and mechanical engineers, founders, smiths, wire drawers, tube makers, saddlers, rubber manufacturers, oil refiners, platers, japanners, ironmongers, carriers by land and water, contractors, &c. The first subscribers (each with one share) are:—F. Howard, 65, Digby Road, Brownswood Park, N., clerk; F. Hopkins, 29, Heron Road, Herne Hill, S.E., shorthand writer; O. W. Bollon, 431, Liverpool Road, N., clerk; C. M. Murphy, 31, Victoria Road, Chelmsford, clerk; H. J. Taylor, 40, Greville Road, Walthamstow, N.E., clerk; H. Hill, 182, Leander Road, Brixton Hill, S.W., accountant; and R. M. Albery, Bowery Farm House, Wraysbury, farmer. The number of directors is not to be less than three nor more than eight; the subscribers are to appoint the first; qualification, £100; remuneration, £50 each per annum, and £50 extra for the chairman.

Medical Battery Company, Limited (67,755).—This company was registered on November 10th, with a capital of £5,000 in £1 shares, to acquire the business formerly carried on by W. Willmott, and to provide for and carry on the treatment of disease by means of galvanic, electric, and magnetic appliances and otherwise. The first subscribers (each with one share each) are:—W. Willmott, 26, Queen's Road, Leytonstone, E., electrician; H. Perry, 70, Pevensey Road, Forest Gate, clerk; A. T. Ellis, 31, Gt. St. Helens, E.C., articled clerk; J. H. Stuart, Westleigh, East Ham, E., civil engineer; G. C. Baldock, 6, St. Ann's Road, Burdett Road, Bow, E., clerk; W. H. Butterfield, 51, Sydney Road, Hornsey, N., clerk; and H. Forbes, 18, Malden Road, Watford, Herts., shipbroker. The number of directors is not to be less than two or more than five. The first are W. Willmott and others to be appointed by the company. Remuneration, 5 per cent. of the net profits, divisible.

CITY NOTES.

The Cape Electric Tramways, Limited.

The fourth ordinary general meeting of the shareholders of this company was held on Wednesday at Winchester House, Sir Charles Euan-Smith, K.C.B., in the chair.

In proposing the adoption of the report, the Chairman said it was a great pleasure to the board to feel that on this occasion they could again honestly congratulate the shareholders upon the result of the operations of the company during the year under review. These should certainly prove to the shareholders that the anticipations of increasing success, which were expressed to them last year, had been fully justified. As they would have seen by the balance-sheet, they had for the year under review, after fully providing for all debenture interest, paid them 9 per cent. interest on their capital, as against 6½ per cent. in the preceding year. They had been enabled to carry the unusually large sum of £20,000 to the credit of their reserve funds, as against £8,000 in the preceding year, and they now recommended the payment of a further bonus of 3 per cent. on the share capital, which would absorb £12,000. They further proposed to carry forward the sum of £12,000 to the credit of next year's account. From that, however, certain moderate payments had still to be made. When they considered the troublous times which had ruled in South Africa during the last year—and that in consequence thereof many first-class enterprises in that country had had either to submit to a very considerable reduction in their usual dividends, or, indeed, to forego them altogether—the balance-sheet of their company must certainly be regarded as representing an extremely satisfactory position. As to the further payment of the 3 per cent. on the share capital which now awaited their sanction, the board had recommended that that should take the form of a bonus, instead of the final dividend, as they recognised that some of the causes that had been in operation to swell the receipts during the past year, owing to the incidents of the war, could not be regarded as in themselves of a permanent character, and they had deemed it better to be on the safe side in thus acting. This they could easily understand; they felt, however, that in the future they might confidently look forward, with the restoration of peace, to future development of fresh sources of income. The receipts for the four months, since the annual accounts were closed from July to October, had amounted to £14,450. The company might be, therefore, certainly regarded as still making progress in the public favour commensurate with the efforts which they always made, and intended to make, to meet all public requirements. In the Cape Town system they had carried nearly three million more passengers than they did in the preceding year, while in the Port Elizabeth system, which, of course, was much smaller, they had an increase of over 400,000. As regarded the action which was brought by the Eastern Telegraph Company, Limited, against the company, it was with great satisfaction that the board received the news that a full bench of judges of the Supreme Court in Cape Colony had, in the month of February last, given a unanimous verdict in their favour; but, as stated in the report, an appeal against that decision had been lodged before the House of Lords, and, until that had been decided, nothing further could be said in regard to that important question.

Dr. Rutherfoord Harris seconded the motion, and the report was adopted.

The Chairman, in proposing a resolution increasing the capital of the company by the creation of 100,000 additional ordinary shares of £1 each, said it was the intention of the board whenever the capital was issued to offer it to the existing shareholders *pro rata* at such premium as the financial position of the company might in the opinion of the board warrant. It was not proposed to issue more than 40,000 shares, which would amount to one in ten being offered to every existing shareholder on the basis of his present holding.

The resolution was unanimously agreed to.

West India and Panama Telegraph Company, Limited.

Mr. W. Andrews (chairman) presided on Wednesday over the forty-seventh ordinary general meeting of the above company, held at Winchester House, E.C., and in moving the adoption of the report said he did not intend to go much into detail. The expenses had increased by £240. There was a decrease on general charges of £1,043, but on the other hand, repairs to cables and landlines had cost £1,282. The directors could not control those repairs. The receipts were £27,737, against £30,929, a decrease of £3,191. Of this decrease traffic receipts accounted for £1,233, subsidies for £984, and exchange for £453, and one or two small items made up the remainder. They therefore seemed to have about bottomed the decrease of the traffic account. The most important matter really was to consider the policy of the company, and what had been taking place in recent times. The shareholders had had the correspondence that had been exchanged by the company with the Colonial Office. The directors had thought that they were entitled to more consideration from the Government than the Government seemed inclined to show. The company showed that the present unsatisfactory financial position of the company was brought about by the introduction of a competing line of traffic to and from Jamaica, and the West Indies generally. This competing cable was worked at artificially low rates, which were only made possible by the Government subsidy. The traffic for messages by this new line was actually fixed by Parliament, and since the Spanish-American war, when traffic had assumed its normal dimensions, the traffic of those competing lines was only one-half of the revenue, while the other half came from Government subsidies. Without the assistance of the latter those companies could not pay out of messages their statutory debenture obligations or sinking funds or dividends. That proved, therefore, that the original stimulated demand for lower tariffs for West Indian telegraphic communication was not practicable, because of the paucity of business. It also proved that the introduction of the lower rate for telegrams between Jamaica and Europe was not the natural result of fair competition by any company, but was originated by Parliament and rendered possible only because of the subsidies given by Government. It was consequently a Government production and not a company production, but as a consequence the outcry throughout the West Indies for further reductions between Jamaica and this company's stations became so great, and the company were so strongly urged to assist West Indian commerce, and the promises of support were so great, that the company made large reductions. Well, they knew that the support promised was not forthcoming, and the business had gone from bad to worse. They approached the Colonial Office with a view to getting subsidy, believing that a continuation of the low rates would aid West Indian commerce, and, at the same time, benefit the company. The Treasury, as they were aware, viewed the application for aid with disfavour, but the directors believed that their case was a proper one for Imperial aid. No doubt the Treasury wished to do right, but they must try and convince them that justice was on the side of the company. A great deal had been made of an all-British cable between Jamaica and the other West Indian islands. As a fact, the company had already drawn the attention of the Government to the fact that with their duplicated cable they were in a position to give an all-British cable, embracing Demerara as well as the other British West Indian islands. However, the directors were glad to know that there were grounds for believing that there would be a revival of the trade of the islands. Under those circumstances the directors could not feel that this was just the moment to raise rates. Just as trade appeared to be budding and likely to blossom and bear fruit, it did not seem quite the time to nip it in the bud by raising rates. What they felt inclined to do was to urge the shareholders to hold their ground for the present in the situation in which they were placed, and to allow the directors to be guided by circumstances, and they would do their utmost in all directions for the benefit of the shareholders.

Mr. H. Holmes seconded the motion for the adoption of the report.

Considerable discussion ensued in which the action of the Colonial Office was severely commented upon, and suggestions were made that the rates should be at once raised, while one shareholder thought they might offer to sell the cable to the United States or Germany.

Mr. Edwards moved an amendment to the effect that the reserve fund should be utilised to pay off the mortgage debentures, thereby effecting a saving of £900 a year, and further, that it was not to the interests of the company that proxies should be sent out by the board before the meeting.

The Chairman said the reserve fund was of vital consequence to the company, and, in fact, that such an amendment was moved showed the importance of the board sending out proxies, for otherwise the shareholders present, by a scratch resolution, might carry a proposal in ignorance of its effect on the company.

The amendment found no seconder, and the report was adopted

Walker and Wallsend Union Gas Company.

On 9th inst. an extraordinary general meeting of the shareholders of this company was held at the offices, Mitchell Street, Walker, to pass a resolution sanctioning the creation and issue of new stock for the purpose of raising additional capital authorised by the Company's Electric Lighting Act, 1899, and the Electricity Capital Act, 1900. Col. Crawford presided.

The following resolution was passed unanimously:—

That the company create and issue the whole of the ordinary shares remaining unissued in the electricity capital of the company, authorised by the Walker and Wallsend Union Gas Company's Electric Lighting Act, 1899, and raise £25,000, part of the additional capital authorised by the Walker and Wallsend Union Gas Company's Electrical Capital Act, 1900, by the creation and issue of new ordinary or preference shares of the nominal amount of £10 each, or of new ordinary preference stock as the directors may from time to time determine, and that the directors be hereby authorised from time to time to dispose of such shares or stock in such manner as the directors shall think advantageous to the company.

The Chairman stated that the electricity works at Walker were rapidly approaching completion.

The British Electric Traction Company.

The interim report, to which we briefly referred last week, reads as follows:—

"The directors have decided to pay an interim dividend on the ordinary shares on December 22nd next (being six months after the last payment of dividend) at the rate of 6 per cent. per annum for the half-year ended September 30th on account of the dividend for the financial year ending March 31st, 1901, which is at the same rate per cent. per annum as the interim dividend paid last year. Satisfactory progress continues to be made by the company and its associated companies, and the aggregate traffic receipts on the various lines in operation show a considerable increase.

"New Lines Opened for Traffic, &c.—*Swansea Improvements and Tramways Company.*—The tramways (5½ miles) owned by this company were opened for traffic by electric traction on June 30th, 1900, and are working satisfactorily. The receipts have increased by about 60 per cent., while the expenses of working have been relatively reduced. *Potteries Electric Traction Company, Limited.*—This company is now working 24½ miles by electric traction, and a further 4¼ miles are ready for working. The traffic receipts on all the lines are satisfactory. *Dudley, Stourbridge and District Electric Traction Company, Limited.*—Since the date of the last report 3½ miles of lines have been opened for traffic by electric traction, and a further 5 miles will be opened as soon as the Board of Trade have given their certificate. The traffic receipts are satisfactory. *Dudley and Wolverhampton Tramways.*—The section of the line from Dudley to Sedgley, 2½ miles, has been reconstructed, and was opened for traffic by electric traction on October 3rd, 1900. *Kidderminster and District Electric Lighting and Traction Company, Limited.*—The electric lighting supply under the order tranferred from the Kidderminster Corporation was commenced in August. *Tynemouth Electric Traction Company.*—The lines (4 miles) owned by this company are practically completed, and will be opened for traffic as soon as the Corporation are ready to supply the current.

"Additional Powers Obtained.—Light railway orders granted subject to the approval of the Board of Trade:—Durham and Brandon, 2¾ miles; Jarrow and South Shields, 3¼ miles; Morley and District, 7 miles; Spen Valley (Extensions), 9 miles; Barnsley (Extensions), 4½ miles. *South Staffordshire.*—The two light railway orders granted by the Light Railway Commissioners (7 miles) have been confirmed by the Board of Trade. *Wellingborough.*—An Act of Parliament has been obtained for the construction and working of tramroads in this district (19 miles). *Peterborough.*—The order granted by the Light Railway Commissioners (5½ miles) has been confirmed by the Board of Trade. *The Poole and District Electric Traction Company, Limited*, has obtained an Act of Parliament for the construction and working of tramways (3¾ miles) in Christchurch and Bournemouth, subject to the provision that if within a certain period the Corporation of Bournemouth under powers granted them construct that portion of the line within their borough, the company's power to construct it shall cease, but they shall be entitled to running powers. *The Kidderminster and District Electric Lighting and Traction Company* has been granted a light railway order for an extension to Bewdley (4¼ miles), subject to the approval of the Board of Trade. *The Gateshead Tramways Company.*—The light railway order (2½ miles) granted by the Light Railway Commissioners has been confirmed by the Board of Trade. *The Wigan Tramways Company, Limited.*—The application for a light railway order for extensions has been granted in part (4 miles) by the Light Railway Commissioners, subject to the approval of the Board of Trade. *South Staffordshire Tramways (Lessee) Company, Limited*, has obtained a lease of the whole of the lines of the South Staffordshire Tramways Company as from February 1st, 1900. *The Rothesay Tramways Company, Limited.*—The provisional order granted by the Board of Trade authorising the reconstruction of its lines for electric traction and extension of tenure has been confirmed by Parliament. *Weston-Super-Mare and District Electric Supply Company, Limited.*—The provisional order authorising tramways (3½ miles) granted by the Board of Trade, has been confirmed by Parliament. *Leamington and Warwick Tramways and Omnibus Company, Limited.*—The provisional order granted by the Board of Trade authorising *(inter alia)* the reconstruction of the company's tramways within the borough of Warwick has been confirmed by Parliament. *The Electrical Power Distribution Company, Limited.*—The Bills promoted in the last Session of Parliament for the supply of electric energy in bulk in the County of Durham and North Metropolitan areas have both been passed, and the Acts of Parliament have received the Royal assent. The Board of Trade has approved the transfer to the company of the following electric lighting orders from the authorities who obtained them:—Hertford Local Authority; Lewes Local Authority. The following electric lighting provisional orders granted by the Board of Trade have been confirmed by Parliament:—Banbury; Jarrow; Sevenoaks; Sheerness; Staines, Egham and Chertsey; Wallington; Wellingborough.

"The applications for light railway orders at Blyth and Windermere have been withdrawn for the time being. The Light Railway Commissioners declined to grant the order applied for in respect of Kingston and Surbiton."

J. G. White & Co., Limited.

The first (or statutory) general meeting of this company was held at the offices, 22A, College Hill, E.C., on 7th inst.

Mr. J. G. White (chairman of the company) presided, and, according to an official report, stated that the company was organised on July 10th last, and that the present proceedings were of a formal nature, to comply with the Companies' Acts. He was very pleased to be able to state that the progress of the business since the date of formation had been very satisfactory. The company had considerable work in hand, and some very large contracts in prospect.

Dublin and Lucan Electric Railway Company.

An extraordinary general meeting of this company was summoned for November 12th to consider resolutions authorising an application to be made to the Privy Council for powers to raise £3,750 in 5 per cent. cumulative preference shares of £10 each with corresponding borrowing powers for £1,250, and also for an amendment of the company's order in Council, so as to enable preference shareholders to vote at general meetings, and to reduce the quorum of meeting of directors from three to two. Nothing was done, as the necessary quorum of shareholders was not present.

Prospectus.

The investing public have this week been invited to subscribe for £2,385,000 share capital in the Baker Street and Waterloo Railway Company. That figure represents the total of the nominal capital, and is made up of 66,000 £10 4 per cent. preference shares, and 172,500 ordinary shares (£10). In addition the company has borrowing powers amounting to £794,000. As has been the case with certain other electric underground railway schemes, 3 per cent. interest is to be paid half-yearly during construction. The length of the railway is about 5 miles 2 furlongs, and will be on the Greathead twin tunnel principle as usual. Starting at the Elephant and Castle, on the South, it passes Waterloo Station, thence under the river, up Northumberland Avenue, Charing Cross, the Haymarket, Regent Street, Portland Place, Regent's Park, Baker Street, Marylebone Station (the terminus of the Great Central Railway), and Edgware Road, to Paddington Station. The site for the necessary depôt and generating station is about a quarter of a mile to the South of Waterloo Station. The stations will be placed at or near the following points, viz:—

Elephant and Castle (connecting with the London, Chatham and Dover, and City and South London Railways).
Waterloo (connecting with the South-Western, the Waterloo and City, and South-Eastern Railways).
Thames Embankment (connected by a subway with the District Railway).
Charing Cross (connected by stairs and lifts with the pavements in Northumberland Avenue, Trafalgar Square, and the Strand, within a short distance of the Charing Cross Station of the South Eastern Railway).
Piccadilly Circus.
Oxford Circus (connecting with the Central London Station).
Baker Street (connecting with the Metropolitan Railway).
Marylebone (connecting with the Great Central Terminus).
Edgware Road.
Paddington (connecting with the Great Western Railway).

A large portion of the land required has been already purchased, and satisfactory arrangements have been concluded for the greater part of the remainder. The works between Waterloo and Baker Street, which are being constructed by Messrs. Perry & Co., are in full operation, and this section will be completed and opened for traffic independently of the rest of the line. The engineers' report as to the progress of the works to date is quoted in the prospectus. The speed of the trains will be about 13 miles an hour, including stoppages. The entire distance between the Elephant and Castle and Paddington will be accomplished in about 25 minutes, as against about an hour-and-a-quarter by omnibus.

The line will serve four of the declared largest centres of traffic in London. The prospectus states that:—"Unlike the railways running East and West, which carry chiefly a morning and evening traffic, this line, running as it does through the most important shopping districts in London, and near to the Government offices, clubs, large hotels, and many theatres and other places of amusement, as well as serving important business centres, and also tapping one of the most densely populated artisan districts in London, will doubtless carry a large and continuous traffic throughout the day and a great part of the night. There are exceptional facilities for intercommunication with other lines. As to the working expenses, the engineers of this company, judging by the cost of working other electric railways, estimate that the total working expenses of the line, allowing for 300 trains each way on week-days and 150 trains

The Chairman, in proposing a resolution increasing the capital of

The amendment found no seconder, and the report was adopted

each way on Sundays, may be taken at £100,000 a year. On the basis of the results of the Central London Railway, which has been open for several months, with an increasing traffic, the directors estimate the balance of profit at more than sufficient to pay dividends of 4 per cent. on the preference and 6 per cent. on the ordinary shares.

The carrying capacity of the line with the trains proposed will be more than adequate for the estimated traffic; the number of trains can be considerably augmented, and the length of the stations will also allow of an addition of one-half to the length of the trains, with a consequent proportionate increase in their earning power, so that there will be ample provision for a large growth in the traffic.

Contracts have been entered into with the London and Globe Finance Corporation, Limited, for the acquisition of the necessary land, the construction of the works, and the equipment of the railway with all its appurtenances, including working plant and sufficient rolling stock for a three-minute service, complete in all respects as authorised by the company's Acts, to the satisfaction of the Board of Trade and of the company's engineers, for the sum of £3,096,000, payable as to £2,322,500 in cash or shares, and £773,500 in debenture stock bearing 4 per cent. interest. The Corporation undertake all risks and contingencies of every kind in connection with the construction of the railway and works; they will provide for all Parliamentary, legal, engineering, administration, and other expenses whatsoever during construction; will maintain the line for one year after its opening for public traffic, and will pay to the company the sum of £50,000 for working capital. In addition to this sum there will be available for the general purposes of the company £83,000 from the authorised capital unappropriated. The London and Globe Finance Corporation has disbursed to date in regard to the railway the sum of £654,705 10s. 7d.

The directors are T. J. Hare (chairman), Marquess of Dufferin and Ava, Quinton Hogg, Major-General C. S. Hutchinson, Sir Algernon West. The engineers are Sir Benjamin Baker, W. R. Galbraith, and R. F. Church. Secretary and offices, E. B. Read, 17, Victoria Street, Westminster.

The list of subscriptions closed on Wednesday.

Stock Exchange Notices.—Application has been made to the committee to allow the following to be quoted in the Official List:—Kensington and Notting Hill Electric Lighting Companies—4 per cent. debenture stock. The committee has appointed a special settling day as under:—Wednesday, November 28th, British Electric Traction Company, Limited. Further issue of 10,000 6 per cent. cumulative preference shares of £10 each, fully paid, Nos. 110,001 to 120,000; and 15,000 ordinary shares of £10 each, fully paid, Nos. 75,001 to 99,000, and same are also to be quoted in the Official List.

Telegraph Manufacturing Company.—The directors announce an interim dividend at the rate of 8 per cent. per annum for the half-year ended September 30th, payable 1st prox.

London United Tramways.—The letters of allotment of the issue of £350,000 4 per cent. first mortgage debenture stock, were posted on 9th inst.

Electrical Power Distribution Company, Limited.—Letters of allotment for the recent issue of shares have been posted.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending November 10th, 1900, were £170; corresponding period last year, £182; decrease, £12. Total to date, £19,256; corresponding period last year, £19,243; increase, £13.

The Bristol Tramways and Carriage Company.—The receipts for the week ending November 9th, 1900, were £2,940 16s. 3d.; corresponding period last year, £2,997 19s. 6d.; decrease, £57 3s. 3d.

The Central London Railway.—The receipts for the week ending November 10th, 1900, were £5,699; previous week, £6,564; decrease, £865. Total receipts to date (15 weeks), £76,761. Miles open, 6.

The City and South London Railway Company.—The receipts for the week ending November 11th, 1900, were £1,848; corresponding week last year, £1,082; increase, £766. Total to date, £30,242; corresponding period last year, £18,427; increase, £11,815. Miles open, 1900, 4½; 1899, 3½.

The Cork Electric Tramways and Lighting Company.—The receipts for the week ending November 8th, 1900, were £382 12s. 1d.; corresponding week last year, £374 16s. 8d.; increase, £7 15s. 10d. Total to date, £18,643 13s. 4d.; corresponding period last year, £17,141 10s. 11d.; increase, £1,502 2s. 5d.

The Dover Corporation Tramways.—The receipts for the week ending November 10th, 1900, were £185 7s. 7½d.; corresponding week last year, £171 14s. 1d.; increase, £13 13s. 6½d. Total to date, £9,479 11s. 8d.; corresponding period last year, £8,990 11s. 11d.; increase, £488 19s. 9d. Miles of track open, 8. Car miles run, 1900, 4,970; 1899, 4,633. Number of cars, 11.

The Dublin United Tramways Company.—The receipts for the week ending November 9th, 1900, were as follows:—D. U. T. Co., horse cars, £28 0s. 5d.; ditto, electric cars, £3,51 3s. 3d.; D. S. D. Co., electric cars, £751 12s. 11d.; total, £4,290 16s. 7d; corresponding week last year—D. U. T. Co., horse cars, £265 18s. 4d.; ditto, electric cars, £2,728 18s. 5d.; D. S. D. Co., electric cars, £710 17s. 3d.; total, £3,705 14s. 0d.; increase, £585 2s. 7d.; aggregate to date, £91,205 11s. 2d.; aggregate to date last year, £81,505 9s. 2d.; increase, £9,700 2s. 0d. The mileage worked is 44 miles electrically, 1 mile by horses, as against 35 miles electrically, 9 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending November 11th, 1900, were £1,541; corresponding week last year (includes date of embarkation of Gordon Highlanders for South Africa), £1,684; decrease, £143. Total from July 1st, 1900, £31,926; ditto corresponding period last year, £31,361; increase, £635. Miles open, 6·57 chains.

STOCKS AND SHARES.

Wednesday Evening.

Stock markets generally are dominated by the speculation in the department allotted to American railroad descriptions, and the activity therein has not yet spread any further. It is hoped in the Stock Exchange that the "Yankee boom" may prove the precursor of better business all round, as it has frequently done in former years, but the wish is, of course, the thought's parent. The electrical sections, however, cannot greatly grumble at the week's performance, as a good deal is doing in supply shares, while the excitement over Americans has had a hardening effect upon the prices of those telegraph companies whose lines run to the States. The new promotions, of which we have given particulars in our last few reports, have done the market little good, so far as the introduction of fresh business is concerned. There is, for instance, no benefit derivable at present from dealing in the shares either of the Electrical Power Distribution Company (which a leading Liberal paper, with unconscious humour, announced as the "Electoral" Power Distribution), or of the Baker Street and Waterloo Railway descriptions.

We briefly alluded to the advent of the latter undertaking last week, before the prospectus was made public property. The document has since been issued, and the subscription list closed to-night, Wednesday. As a new means for relieving the congested traffic of the metropolis, the company deserves a cordial welcome, but we consider that it will be more beneficial to travellers than to shareholders. The prospectus estimates a probable 6 per cent. dividend on the Ordinary shares, basing its figures on those of the Central London Railway. But seeing that the conditions of the two enterprises must, of necessity, be widely different, the comparison hardly seems to hold good. Those who have sent in applications for shares may do worse than reconsider their action while there is yet time.

The only noteworthy change in the supply list has occurred in Notting Hill Electric shares, which were marked down 10s. on a sale at the exceptional price of 14½. This is exceedingly low, but the seller insisted upon unloading his shares, and the quotation was marked down accordingly. Chelseas are unchanged, the seeming refusal of the shareholders to take up the new issue not having affected the price of the existing shares. The time for applying for the lately-offered new Chelseas was extended for several days—not a very strong course of action at any time, unless there is a peculiarly good reason for it. Charing Cross Preference, issued at 5⅛, are 5⅜, and it is worth remembering that their reception was an extremely cold one at the time they were offered. A good deal of business is being done in Westminsters; the price of the new shares is now 12, half-a-sovereign less than those of the senior issue.

We have already alluded to the rise in Anglo-American Telegraph securities, which is due to the heavy business the company is now securing in connection with the activity in American rails. Anglo "A" has enjoyed the largest proportionate rise, and dividend anticipations are brightening up. Our favourable comments upon the "B" stock, as an investment, are borne out by another rise this week of a point in the price of the Preferred. Commercial Cable Debentures are 1 per cent. better, but Direct United States shares are unchanged. The Eastern group show no alteration; new "Chinas" are quoted at 7 middle.

West India and Panama Telegraph shares are down ½, on Mr. Chamberlain's second refusal to recommend an Imperial grant to the company's funds. We understand that the board have by no means abandoned the hope of obtaining a Government subsidy, despite the two rebuffs, and they certainly deserve credit for their efforts on behalf of the shareholders. Submarine Cables Trust certificates have dropped the advance they made last week. The Telegraph Trust shares are perhaps a thought harder.

As an investment of the next-to-gilt-edged type, we would draw attention to the 4 per cent. Debentures of the West Coast of America Telegraph Company. The bonds are guaranteed, both as to principal and interest, by the old Brazilian Submarine Company—now the Western Telegraph Company. They are repayable in January, 1917, or earlier, at 110, upon the company giving a quarter's notice. Somehow or other these Debentures have escaped the attention which they deserve, and can now be bought at 102, or thereabouts. Against their advantages there has to be set the difficulty of negotiability, the market in them being a very limited one.

While the fall in City and South London Ordinary stock is stayed, weakness has developed in the price of the shares, which has been put down 10s. The "Tube" varieties are a good market, the undivided in particular being in favour, and marking a rise. Of course, as the dividend time draws near, some slight appreciation is sure to come on that account.

National Telephones, after being a dull market, firmed up again, and are better on the week. The Country selling of British Insulated Wire shares has ceased, and the price has recovered £1 since we last wrote.

ment. *The Electrical Power Distribution Company, Limited.*—The line, allowing for 300 trains each way on week-days and 150

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation November 7th.	Closing Quotation Nov. 14th.	Business done during week ended November 14th, 1900. Highest.	Lowest.
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	99	...
119,700	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	85 — 90	85 — 90	...	...
822,700	Anglo-American Telegraph	Stock	3 %	£3 9s.	73/6	52 — 54	53 — 56	...	...
3,088,540	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	97 — 99	98 — 100	99½	98
3,088,540	Do. do. Deferred	Stock	...	18s. %	£1 7s.	10¼— 10¾	10½— 11	11	10 9/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	4 %	3 — 3½	3 — 3½	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	165 —175	165 —175	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	102 —104	103½	103¼
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6½— 7½	6½— 7½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	14½— 15½	14½— 15½	15¼	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104%	...	...
60,710£	Direct United States Cable	20	3¼%	3½%	3 %	10¼— 10¾	10¼— 10¾	10⅜	10⅜
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	148 —153	148 —153	150½	148
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	98 —101	98 —101	99⅜	98
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	113 —118	113 —118	113	112
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14⅜— 15¼	14⅜— 15¼	15 1/16	14⅜
50,000	Do. Nos. 250,001 to 300,000 (iss. at £3 pm. all pd.) £3 pd.	10	...	...	...	... — ...	6¾— 7¼	6 13/16	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	114 —119	114 —119	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	99—102%xd	99 —102%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5⅛%	5¼%	10½—11	10½— 11	10⅝	10 11/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15 — 15½	15 — 15½	15⅜	15⅛
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	12½%	...	31 — 33	31 — 33	32⅛	...
84,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	98 —101	98 —101	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	49 — 53	49 — 53	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	104 —107	104 —107	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	2½%	½— ⅝	½— ⅝	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	4 %	5 %	¾— 1	¾— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	6 %	5 %	4⅛— 4⅜	4¼— 4½	4¼	4 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	13¾	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5 — 5¼	5 — 5¼	...	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 —99	96 — 99	96½	96¼
500,000	Do. 4 % Deb. Stock Red.	100	...	...	...	... — ...	101 —104	103	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	101 —104	101 —104	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	7⅞	7⅛
3,381	Submarine Cables Trust	Cert.	...	...	...	126 —131	125 —130	126¾	125
58,000	United River Plate Telephone	5	5 %	6 %	7 %	4⅜— 5¼	4⅜— 5¼	5	...
16,639	Do. do. 5 % Cum. pref. Nos. 1—16,639	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
23,361	Do. do. Nos. 16,640 to 40,000 £3½ pd.	5	...	...	...	3¼— 3⅜	... — ...	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	98 —101	98 —101	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,071—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	⅛
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Brаz. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	7 %	14½—15	14½— 14⅝	14⅝	14 1/16
75,000	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	103 —106	103 —106	...	...
348,777	Do. do. 4 % Deb. Stock Red.	100	...	...	...	102 —105	... — ...	...	...
88,321	West India and Panama Telegraph	10	2¼%	2 %	2½%	⅝— 1	⅝— ⅞	¾	11/16
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	6½— 7½	6½— 7½	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	6 — 7	5 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	105 —108	105 —108	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref....	5	7 %	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9½— 10½	9½— 10½	...	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 6	5½— 6	5 13/16	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	6 %	6 — 6½	6 — 6½	6 7/16	6⅜
150,000	Do. do. do. % Deb. Stock Red. ...	Stock	4½%	...	...	110 —113	110 —113	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	10 %	6 %	4 %	8½— 9½	8½— 9½	9⅛	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	13 — 13½	13 — 13½	13 7/16	13⅜
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	125 —130	125 —130	127	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	4 %	8½— 9½	8½— 9½	9 1/16	8⅝
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11 — 12	11 — 12	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	108 —111	108 —111	109⅜	109¼
35,500	Edmundson's Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	...	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	101 —104	101 —104	102⅜	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1⅞— 2¼	1⅞— 2¼	2	...
49,840	Do. do. do. do. 6 % Pref.	5	...	6 %	...	4½— 5½	4½— 5½	4⅝	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	100 —102	100 —102	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	13½— 14½	13 — 14	13⅜	13¼
220,000£	Do. 4½% First Mortgage Debenture Stock	...	4½%	...	...	112 —115	112 —115	...	...
250,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	97 —100	97 —100	98	97
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	15 — 16	14½— 15½	14½	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	15⅞	15 5/16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9	8 — 9	8 1/16	8⅛
150,000	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	99 —101	... — ...	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	85 — 95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	12 %	13 %	12 — 13	12 — 13	12¾	12½

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.
Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Nov. 7th.	Closing Quotation Nov. 14th.	Business done week ended Nov. 14th, 1900. Highest	Lowest
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	9 — 10	9 — 10	...	...
300,000	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	91 — 95	91 — 95	...	...
45,000	British Electric Traction	10	...	6 %	...	13 — 14	13½ — 14½	14⅜	13 1/16
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12 7/16	12
350,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	120 —123	120 —123	122	121½
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	⅜— ½	⅜— ½	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000 ...	...	...	...	...	½— ¾	⅜— ¾	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	97 — 99	97 — 99	...	...
70,000	British Insulated Wire Ord.	5	15 %	15 %	20 %	9½— 10½	10½— 11½	9 1/16	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅝— 6½	5⅝— 6½	...	...
90,000	Brush Elecl. Engng., Ord., 1 to 90,000	2	3 %	5 %	6 %	1⅝— 1⅞	1⅝— 1⅞	1⅞	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	106 —111	106 —111	...	...
108,710	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	103 —105	103 —105	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	12½%	15 %	15 %	12¼— 13¼	12¼— 13¼	12⅞	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5 — 5½	5 — 5½	5 1/16	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	S ock	...	...	...	110 —114	110 —114	...	...
206,297	Central London Railway, Ord. Shares	10	...	...	...	10 — 10¾	10¼— 10⅞	10 9/16	10 7/16
78,703	Do. do. Pref. half-shares	5	...	...	...	5 — 5½	5 — 5½	5⅝	5⅛
78,703	Do. do. Def. do.	5	...	...	...	5 — 5½	5 — 5½	5¼	5⅛
855,000	City and South London Railway	Stock	1⅞%	2⅛%	1⅞%	54 — 58	54 — 58	...	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000 ...	10	...	...	...	5 — 6	4½— 5½	5½	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	...	6 %	7½%	3½— 4	3½— 4	...	...
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	6 %	1⅞— 2¼	1⅞— 2¼	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	6 %	3½— 4½	3½— 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	90 — 92	90 — 92	90½	90
100,000	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	96 —100	...	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	2 3/16	2
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	7 %	...	2⅜— 3¼	2⅜— 3¼	3 1/16	...
182,500	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	12½— 13½	12½— 13½	12⅔	...
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5½— 5⅝	5½— 5⅝	5 9/16	5¼
50,000	Do. do. do. 4½ % Mort. Deb. Stock...	Stock	4½ %	...	...	108 —112	108 —112	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	20 — 21	20½— 21½	20⅝	...
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	99 —102	99 —102	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	3¾%	8⅞— 9	8 1/16— 9 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5	12¾— 13¼	13 — 13¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	36 — 40	36 — 41	37½	36⅝
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	... %	101 —104	101 —104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	8 %	12 %	10½— 11½	10½— 11½	10⅞	10½
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½— 5⅝	5½— 5⅝	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	92 — 95	92 — 95	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Brompton and Kensington, 4½ % Debentures of £100, 103—106.
National Electric Free Wiring, 12/6 paid, ⅜—⅝.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16¾—17½.
Do. do. Pref. (£10 pd.), 10—10¼.
* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 % £5 (fully paid), 6¾—7½. Debentures, 102—105. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 17⅝.

Bank rate of discount 4 per cent. (July 19th, 1900).

MARKET QUOTATIONS, Wednesday, November 14th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	32/-	32/-	..
a Ammonia, Muriate (crystal) ..	per ton	£32 10	£32 10	..
a ,, ,,	per ton	£90	£90	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17 10	£17 10	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£25	..
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks ..	per lb.	8¾d.	8¾d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	64/-	64/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..
METALS, &c.				
b Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£80 to £150	£80 to £145	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8¼d.	8¼d.	..
c ,, Wire, basis	per lb.	8¼d.	8¼d.	..
c Copper Tubes (brazed) ..	per lb.	11¼d.	11¼d.	..
c ,, ,, (solid drawn) ..	per lb.	11d.	11d.	..
g Copper Bars (best selected) ..	per ton	£86	£86	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£86	£86	..
g ,, Rod	per ton	£86	£86	..
e ,, (Electrolytic) Bars ..	per ton	£83 10	£83 10	..
e ,, ,, Sheets ..	per ton	£92	£92	..
e ,, ,, Rod ..	per ton	£85 10	£85 10	..
e ,, ,, H.C. Wire	per lb.	9¼d.	9¼d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha fine	per lb.	8/6	8/6	..
h India-rubber, Para fine	per lb.	3/11 to 4/1	4/- to 4/1	dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	64/5	65/3	10d. dec.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£11 15	£11 15	..
g Lead, English Ingot	per ton	£17 15	£17 10 to £17 12 6	5s. inc.
g ,, ,, Sheet	per ton	£19	£19	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 2 6	£9 5	2s. 6d. dec
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£3 18	£3 18	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£131 to £133	£132 to £133	£1 inc
g ,, foil	per lb.	2/-	2/-	..
n ,, wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	9½d.	9½d.	..
j ,, Best Flax, 6 lea.	per lb.	6½d.	6½d.	..
j ,, Hemp, 8 ply 10 lbs. ..	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5½d.	5½d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14 10	£14 10	..
k Zinc, Sh't. (Vielle Montagne ord.)	per ton	£23 2 6	£23 2 6	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Henry C. Yee & Co.

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Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.

INSTITUTION OF ELECTRICAL ENGINEERS.

INAUGURAL ADDRESS

By Prof. John Perry, M.E., D.Sc., F.R.S., President.

In this address I mean to put before you this simple question: Is electrical engineering to remain a profession or is it to become a trade? Is this Institution to continue to be a society for the advancement of knowledge in the applications of scientific principles to electrical industries, or is it to become a mere trades union?

Of course, at the present time the outside public are willing to regard membership of this Institution as a symbol of something more than the membership of a mere trades union. During the early growth of any trade, even such a trade as that of the plumber, it was really a profession. And a common trade may suddenly become a profession, if it suddenly begins to develop, as, for example, stonemasonry of 100 years ago suddenly developed into civil engineering. Electrical engineering has been developed rapidly, so that in the past it has certainly been a profession and not a trade.

Again, we are an institution of engineers, and the general public are willing to class us with other engineering institutions—for example, the Institution of Civil Engineers. Now the title M.Inst.C.E. is a professional distinction which represents in civil engineering what F.R.C.S. does in surgery, or M.R.C.P. in medicine. We owe a great deal to our association with, and recognition by, the Institution of Civil Engineers; our meetings are held in its rooms; many of our members are also its members; our proceedings are modelled on its proceedings.

Now this older Institution, governed by the best thoughts of the best British engineers, has laid it down that its associate members, that important class from which the higher class is mainly fed, shall have passed certain specified examinations in pure and applied science.

I am not now suggesting that we ought to adopt this science examination method of admitting any kind of members to our Institution. I do not believe in the wholesale adoption of methods of working from another society. I am asking you early in my address to remember that this greatest of all professional engineering institutions, governed by practical men full of common sense, knowing the wants of their profession well, insists upon a knowledge of science in its new members. If this recognition of science did not exist anywhere else in the whole world, I say that its recognition by such a thoroughly good professional society as that of the Civil Engineers ought to recommend it to all professional societies.

In Germany an enormous stride has recently been made in the raising of engineering degrees to rank with the highest University honours. There is hardly one engineer of eminence in Switzerland, France, or Germany who has not passed with honour through the classes of one of their great science universities.* In Great Britain within the last 15 years not only have great engineering schools been established in all the manufacturing towns, but even in Cambridge University there is one of the best schools of civil, mechanical, and electrical engineering of which I know anything.

Before we think of imitating the Institution of Civil Engineers, we ought to reflect on certain fundamental distinctions between that institution and our own which at first sight seem to make us less professional.

There is a well-known unwritten rule of the Civil Engineers to which there are only few exceptions, that no contracting railway or harbour engineer can acquire the title of M.Inst.C.E. I think myself that it is a pity to draw a hard and fast line between consulting engineers and contractors. No doubt it simplifies the labour of the council in its selection of candidates, but it gives rise to anomalies.

A man who was once a civil engineer because he served a pupilage under his clever father, and who now is nominally at the head of his father's large practice, the real engineering work being done by many clever employés, this man may be a member. A contracting engineer who shows marvellous ability not only in rectifying the mistakes of the designer of a large bridge or tunnel or reservoir embankment, but shows the power of Lord Kitchener in directing the work of thousands of men so that no man need be idle, and the whole contract goes on like clockwork, and is finished well in the minimum of time, this man is ineligible. Now, in our Institution, it has been recognised from the very first that manufacturers and contractors and their employés may belong to the very highest ranks of their profession. Of course, I do not mean men who simply receive the profits of businesses, or even men who merely work to obtain orders for themselves. I mean men who are not merely formally, but in reality, manufacturing or contracting engineers. I mean men who, in dealing with standardised things, design new methods for quick, good, cheap production of such things. I mean men who improve old forms of things, possibly through their paid subordinates. I mean by a manufacturer fit to be a M.I.E.E. a man who might act as his own manager, and who, perhaps, has a wider outlook than on mere managerial duties. So long as a contractor or manufacturer is really an engineer, we know that we add to our strength with the addition of every such member.

But consider a contractor who only uses ordinary types of machines or electrical plant in well-known ways, surely he can hardly be said to be in the profession at all. Surely the one thing that differentiates us from mere tradesmen is, that we do not follow mere rule-of-thumb methods; we think for ourselves, we weigh advantages and disadvantages. If every new installation required the same treatment as existing ones, the engineer would degenerate into a tradesman, and it seems to me that the electrical engineer ought to have a special fear of such degeneration.

In railway and harbour and river and sanitary engineering, in every new job there are new difficulties to be dealt with. An engineer who designs many undertakings, and sees them carried out, must be a thoughtful man; he cannot help keeping himself acquainted with engineering principles, and so he is a professional man. So an architect finds that each new job requires all his experience. Every case that comes before a real physician or surgeon requires a somewhat different treatment from any old case. Every case brought before a barrister requires the exercise of all his past experience. In every case a *profession* implies the necessity for the exercise of all one's past experience, because the work one has to do is never the same as any work one has ever done before. And when I say past experience, I really mean certain general principles which one has always in one's mind, principles derived from all that one has done, or seen, or read about.

Electrical engineering is in a curious position. It owes its being altogether to scientific men, to the laboratory and desk work of a long line of experimenters and philosophers. Even now the work going on in a laboratory to-day becomes the much larger work of the engineer to-morrow. When at length the laboratory experiment is utilised in engineering, we see that there is no other kind of engineering which so lends itself to mathematical treatment and exact measurement. Most of the phenomena dealt with by the electrical engineer lend themselves to exact mathematical calculation, and after calculations are made, exact measurements may be made to test the accuracy of our theory; for a completed machine, or any of its parts, can be submitted to the most searching electrical and magnetic tests, since these tests, unlike those applied by the mechanical engineer, do not destroy the body tested.

Contrast this with the calculations it is possible to make in other kinds of engineering. The pressure of earth against a revetment wall is probably 200 or 300 per cent. greater, or 50 to 70 per cent. less than what we imagine it to be in what some limited men call theory. We use factors of safety 5 or 10 or more on all kinds of iron structure calculations, because we are aware of our ignorance of a correct method of dealing with the problems. The civil engineer never has exactly the same problem as has already been solved. In tunnelling, earthwork, building, &c., in making railways and canals, he is supremely dependent on the natural conditions provided for him: the configuration of the surface of the ground, the geological formation, the structural materials available in the neighbourhood. The story of how the engineer has to study the endlessly different ways of interaction of water and sand and gravel is told by the troublesome bars at the mouths of rivers all over the world, by the difficulties of coast and river-bank protection, by the failure of sea walls and piers. But why should I make a catalogue of the different kinds of work done by civil engineers? Every one of them needs the exercise of general scientific principles due to much experience.

Now of all such natural difficulties, the consulting or contracting electrical engineer is greatly independent. Give him a source of power and tell him what is to be done; whether he is to light a town or a building, whether with arc or incandescent lights; whether he drives a stamp mill near a mine or a pump, or a machine tool, or a spinning frame, the electrical part of the work is carried out in much the same way. Natural conditions affect him mainly in the cost of transport of his materials, and the cost of labour. He can make in an easy way the most careful calculations as to the best arrangement of his conductors and machines to give maximum economy, and except for this easy calculation his work is that of a mere tradesman. He is practically independent even of the weather. There are, indeed, some of us who grumble that this easy calculation is not made easier still, who prefer to make arithmetical guesses rather than exact calculation, because, perhaps, we like to see a little uncertainty introduced into the problem to make it more like a problem in civil engineering. I want members to see clearly that as time goes on, as our electrical engineering work gets more and more cut and dried, the man who loses the power to calculate, who loses his grip of the simple theory underlying our work, must sink more and more into the position of a mere tradesman who has no longer the right to call himself an engineer.

An electrical engineer must have such a good mental grasp of the general scientific principles underlying his work that he is able to improve existing things and ways of using these things. It has become the custom to call this *theory*, and I suppose I must follow the custom. I should prefer to call it *science** or *knowledge*. Do you

* I understand also that the great unions of manufacturers in *Germany* are about to make facilities for giving a year of real factory work to the Polytechnic students, thus perfecting the German system. In Japan we found great success in requiring students to spend their summer in real shops, their winters at college. In England it may be that we shall prefer to let apprentices have shorter factory hours than workmen, their masters being responsible for instruction being given in theory.

* What Falstaff said of the word "occupy" we have to say of the word "science." It is used by many people out of its proper meaning, and then condemned, so that one is getting afraid to use it. In Prof. Fitzgerald's splendid inaugural address to the Dublin Section of this Institution, he says: "As has recently been pointed out to me by Dr. Trouton, it would be impossible to say the same contemptuous things of *knowledge* as are said of *science*. In Germany the word used, 'Wissenschaft,' is the one corresponding to our word 'knowledge,' and there nobody of any sense could say that 'knowledge is all humbug,' as is here often said, and still oftener thought, of 'science.'"

Quotations supplied by
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons.
e Messrs. Frederick Smith & Co.
supplied by
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.
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p The Phosphor Bronze Company, Ltd.

remember Huxley's definition of Science? "Science," he said, "is organised common sense"; and this is really what I mean. Well, calling it *theory*, the man who is permeated by theory, whose theory is so much a part of his mental machinery that it is always ready for practical application to any problem, he is the real engineer. But you must not mistake me in this matter. Eighty per cent. of the men who pass examinations in mathematics, mechanics, and electricity have very little of this theory. Fifty per cent. of the writers of letters in the engineering journals in which mathematical expressions occur have almost nothing of this theory in their possession. It is unknown to foolish men. Books alone, lectures alone, experiments alone, workshop experience alone cannot teach this theory. The acumen of a Q.C. may actually prevent a man from acquiring it. A man may have much of this theory, although he may never have listened to lectures, although he may dislike the sight of a mathematical expression. I have known men who might be called illiterate to possess much theory. I have known many men who might be called good *electricians* who are almost wanting in the theory necessary for the electrical engineer.

I am speaking only of theory. Of the other qualifications for an engineer I need not here speak; they are present to the minds of all of us. A man may have any amount of knowledge; he may know how to apply his knowledge, and yet he may not be able to apply the knowledge from a want of engineering *character*.

The engineer must be a real man; he must possess individuality, the power to think for himself. He must not be like a sheep, knowing only enough to follow the bell-wether. Over and over again in the last 30 years have some of us given our students much the same sort of advice that Baden-Powell gives to scouts in that excellent little book of his. If any of you have not read that book you ought to buy it at once, and you will there find that if a man is to think for himself he must possess all kinds of knowledge, he must be constantly picking up new kinds of knowledge.

Nobody can limit the value of any kind of knowledge, but still one may say that certain things are probably more important than others. To gain what we call "theory" a good general education is most helpful—mathematical knowledge is very helpful; laboratory and workshop experience are extremely helpful. There is one qualification which the electrical engineer must have, and without which all other qualifications are useless, and if a man has it no other qualification is supremely important, and this absolutely indispensable qualification is that a man shall love to think about and work with electrical things. He must like these not because of the money he can make through electrical contrivances, nor even, I think, because of the name he may make before the world—this would be mere liking or cupboard love which has no lasting quality. So long as we have men in this country who have the true love for scientific work of which I speak, so long shall we have a real profession of electrical engineering, for such men are always scheming new contrivances and improving old ones and utilising the services of all helpful people, and especially of capitalists. When we have reached a state in which nobody schemes new things because the existing things are perfect there will no longer be a profession of electrical engineering. Of all ideas surely that of having reached *perfection* is most hateful; the idea of exact knowledge, that nothing is unknown, that there is no need for thought, and therefore that to think for oneself is a sin.

And so, although we are all agreed that much standardisation in our contrivances and methods is absolutely necessary for our competition with other nations, we must follow the Americans in this matter and take care that it does not destroy invention. Of course, when things are really standardised, when we have our perfect Mauser rifle or dynamo or locomotive or traction engine or electrically-driven stamp mill, a Boer can buy or even manufacture them if he has money, and he can use them as well as, or possibly better than, we can. But he is not an engineer. He uses things after the engineer has done his work upon them. A stoker, a common engine driver, the guard of a train, these are not engineers. You must have noticed that the American engineers, who surely deserve the character of being practical idealists above all other engineers, are the men who are most imbued with the notions of standardisation which lead to cheapness of manufacture, and they are also the men most alive to the necessity of occasional extensive scrapping of types of machinery when they become even a little antiquated.

Our chiefs, the men who run us all, our real men at this Institution, may be called practical idealists. They have imagination, and judgment, and individuality. They have the imagination and enthusiasm of inventors, and yet they are more than inventors, for they can estimate the worth of their own inventions, and control their imaginations. They are ready to receive all new ideas, they welcome all new things, and yet they are not carried away. They are radicals, and yet they are conservatives. They have what Mrs. Beecher Stowe called *faculty*.

A strong imagination well under control, surely it is the greatest of mental gifts. I look around me and wonder how many of us really have it, and how many of us are only dull music-hall loving men, who scorn novels and poetry, who live utilitarian, material lives, whose aim is merely to make money through electricity, who love it not for its own self, who cherish their "tuppenny-ha'penny-worth" of theory because it is sufficient for their immediate wants. Why, even the writers of leading articles in the daily papers can talk of the wonders of electricity, and what may yet come to pass, and yet we, who make machines, and use them, and switch the marvellous thing on and off, and take all sorts of liberties with it—we are like Calibans, oblivious of the wonders of the fairy isle—like soulless priests making a living in the temple of Isis—like Aladdins who rub our lamp only to get the necessaries of life.

Twenty years ago some of us were laughed at for our optimism, and yet everything that we declared then to be doable has now actually been done by engineers, except the thing which was then and is now declared to be the supremely important thing, namely, the electric consumption of coal. We say now, as we said then, "The applied science of the future lies invisible and small in the operations of the men who work at pure chemistry and physics." And think of the wonderfully rapid rate at which laboratory discoveries have been made in the last 11 years, and how as the years go on they become more and more numerous; and yet many of us plod along with our work seeking no farther than our noses. A year is now more pregnant with discovery than a hundred years used to be, and yet the protective stolidity of our ancestors is upon us, and we think of the latest discovery as if it were really the very last that can be made. A thousand men are measuring and trying new things in laboratories all over the world. Some of them plodding and soulless; others of them with imagination and clearness of vision. Do you think that nothing is to come from all that work?

And is it not one of the most important functions of the engineer to do as Mr. Marconi has done, to convince capitalists ignorant of science that if the successful laboratory experiment is tried on the large scale it must also be successful? And are we going to leave all this pioneering work, with all its possibilities of great gain, albeit with possible loss, to foreign engineers, when in most cases the scientific discovery has been made in England? Are we so lacking in the hope and faith which are born of imagination and science? And must we in the future as in the past have to rely upon the influx of the clever foreigner like Sir William Siemens? Must we, Boer like, always depend upon our uitlander population, Fleming and German, Hollander, Huguenot and Hebrew, for the development of our natural resources?

Some of the best engineers I know are so exceptional, that one must class them with geniuses; they have faculty and character, and so they have become engineers even under the most unfavourable circumstances. They have passed through ordinary schools and yet developed common sense. They were pitchforked into practical work, and their liking for the work as well as some curious kind of instinct led them to pick up all sorts of knowledge which have become part of their mental machinery. They continue to pick up new kinds of knowledge when these become necessary for their professional work. Unfortunately these men do not realise how exceptional they are, and they advise boys to go direct from school into works. They forget that the other 99 per cent. of men treated in the same way as themselves can only become the hewers of wood and drawers of water to real engineers. Treated in this way, average boys are just like so many sheep: they learn just what seems absolutely necessary and no more; their acquaintance with the scientific principles underlying their trade is a hand-to-mouth knowledge, which becomes useless when their trade undergoes development.

In 1867 I was an apprentice, and when in the drawing office and pattern shop I remember well how I was chaffed for studying such a non-paying, non-practical subject as electricity. When I published my first electrical paper in 1874 before the Royal Society, and even for some years afterwards, the real students of electricity in England could be counted on the fingers of one's hands. Many of us remember the first Gramme magneto machine that came to this country, a scientific toy, in 1874. How many engineers dreamt that a great new branch of engineering had been started? Even in 1878 engineers were as a rule quite ignorant of electricity, and since then every year, although newspaper writers have talked largely of the age of electricity, the men actually engaged in electrical industries have acted as if the greatest of changes were not perpetually going on in it. To be left behind, or to become camp followers, children of Gibeon, this is the usual fate of the men who scorn theory. In 1882—4 we used to have to pay men £200 and £300 a year because they had a slight knowledge of electrical matters. In 1884—6 these very men were not worth 20s. a week, they were weeded out of the profession and their places were taken by men of better knowledge. Two or three years after, these better men were again found to have been weeded out, because men of still better knowledge were available. And so it has gone on ever since. Men learn just enough to get posts; they settle down in these posts and scorn theory. They actually forget what little theory they once did possess. They know a great deal about existing machines, but presently they discover that improvements have been going on, and that they no longer have a right to say that they belong to the engineering profession. In every year one has told men, "You will be left behind. See A and B and C. I told them three years ago, when their names were in everybody's mouths, that they would be left behind, like their predecessors, and they laughed. Now I tell you, and you laugh, and you also will be left behind. Yes, I know that you get a good salary or large fees, and your head touches the sky. Nevertheless, because you neglect theory and the simple mathematics by means of which theory is made available in practical problems, you will have to take a back seat presently, for our profession is in its early youth, and is growing rapidly."

(To be continued.)

Extension of Patent.—Application is being made by the British Aluminium Company, Limited, for a grant of new letters patent, or a prolongation of term of No. 7426, dated May 21st, 1887, granted to A. C. Henderson, of London, for "an improved process for the preparation of aluminium, aluminium bronze, and alloys of aluminium by electrolysis."

ELECTRICAL EQUIPMENT OF A COLD STORE.

The undertaking of the Birmingham Cold Storage, Limited, is devoted entirely to the cold storage of hops. It has a greater capacity for such goods than any other in this country, and is also the largest cold store of any kind driven by electricity. It is situated in King Edward's Place, Birmingham. Provision has been made for extension, and when this is completed, there will be accommodation for 14,500 pockets of hops.

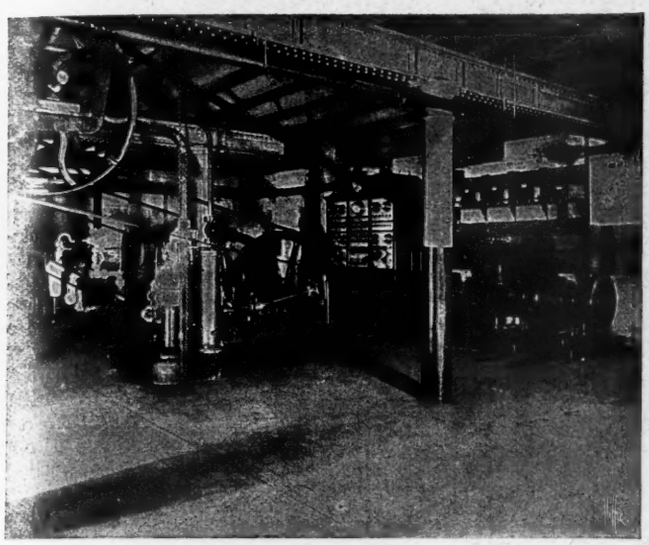


Fig. 1.—The Engine Room.

The refrigerating machinery in the basement consists of two independent ammonia compressors driven from a countershaft by means of two 35-B.H.P. electric motors, and arranged so that either motor can drive either compressor.

In an adjoining building is a deep well, with treble barrel pumps driven by another electric motor arranged in a corner of the compressor room. The pumps deliver into a tank in the roof, and provide an ample supply of water at an almost constant temperature of 54° F. summer and winter. An engineer's shop for carrying out repairs is also situated in the basement, and the various machine tools can be driven either from the main compressor countershaft or from an independent electric motor according to circumstances. The air-cooler is situated on the top floor directly underneath the condenser, and consists of two series of expansion coils standing in a brine tank, the whole being enclosed in an insulated chamber with the main delivery and suction air trunks at either end. The coils are so arranged that they may be worked either separately or together. Brine from the tank is sprayed over the refrigerator coils by means of one of Messrs. Drysdale's "Bon Accord" belt-driven centrifugal pumps.

Every room in the store is provided with both suction and delivery air trunks, which, it may be noted in passing, have a total length of nearly half a mile. Air is drawn from the rooms and forced through the air-cooler back to the rooms again by means of a belt-driven Blackman fan capable of circulating 1,800,000 cubic feet of air per hour.

The brine-circulating pump and Blackman fan are driven from a countershaft by means of a 7½ B.H.P. electric motor, as shown in fig. 3.

The ammonia condenser, which is of the atmospheric type, is situated on the roof, the water being pumped up from a well. The condenser is also arranged with two sets of coils, which may be used either separately or together. The plant throughout has been arranged in duplicate, and the pipe connections have been made in such a manner that any portion of one half of the plant can be worked in conjunction with any part of the other half; as the compressors can be driven by either motor it will be readily seen that a total breakdown is practically impossible.

The electric motors are of the inverted bi-polar type, with slot wound armatures, running at 600 revolutions for the 25 H.P. size and 800 revolutions for the 7½ H.P. motors. The commercial efficiencies were specified at 92 per cent. and 87 per cent. respectively, which figures were in both cases exceeded.

The larger motors are fitted with overhung fly-wheels, weighing about 4 cwt. each, the driving pulley being between two bearings; these, as well as the commutator bearing, are provided with continuous lubrication by means of specially-designed ring oilers.

All the motors are shunt wound, and fitted with carbon brush-holders of special design, the "brush" consisting of a dense carbon block bearing radially on the commutator, and fed up by an adjustable spring and lever. All the motors run sparkless up to 50 per cent. overload, and within these limits it was not found necessary to shift the lead of the brushes.

The main switchboard is arranged for 440 volts on the three-wire system, in anticipation of the conversion of the corporation supply, but at present is connected for 220 volts two-wire supply. Each motor is controlled by two specially-designed single-pole switches made by Messrs. Hodges & Todd, Ltd., who also supplied the whole of the instruments. There are also Sturtevant motor starters for the two large motors, fitted below the switchboard, and in convenient positions near the smaller motors there are shunt resistances inserted in the field circuit to regulate the speed exactly according to requirements, independently of the varying voltage of supply.

The wiring of the cold store has been run in wood casing in the cold rooms, and in "Simplex" tubing in the engine room; the whole of the wires and cables have Callender's vulcanised bitumen insulation.

The whole of the buildings, refrigerating and electric machinery, have been carried out according to the specifications and drawings prepared by Messrs. Harrap and Duffield, of Budge Row, E.C., while Mr. John Hewett, B.A., was responsible for the electrical work.

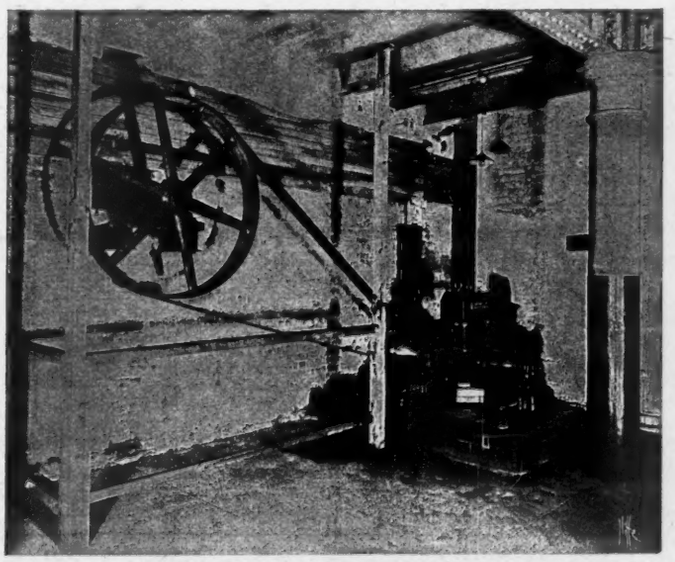
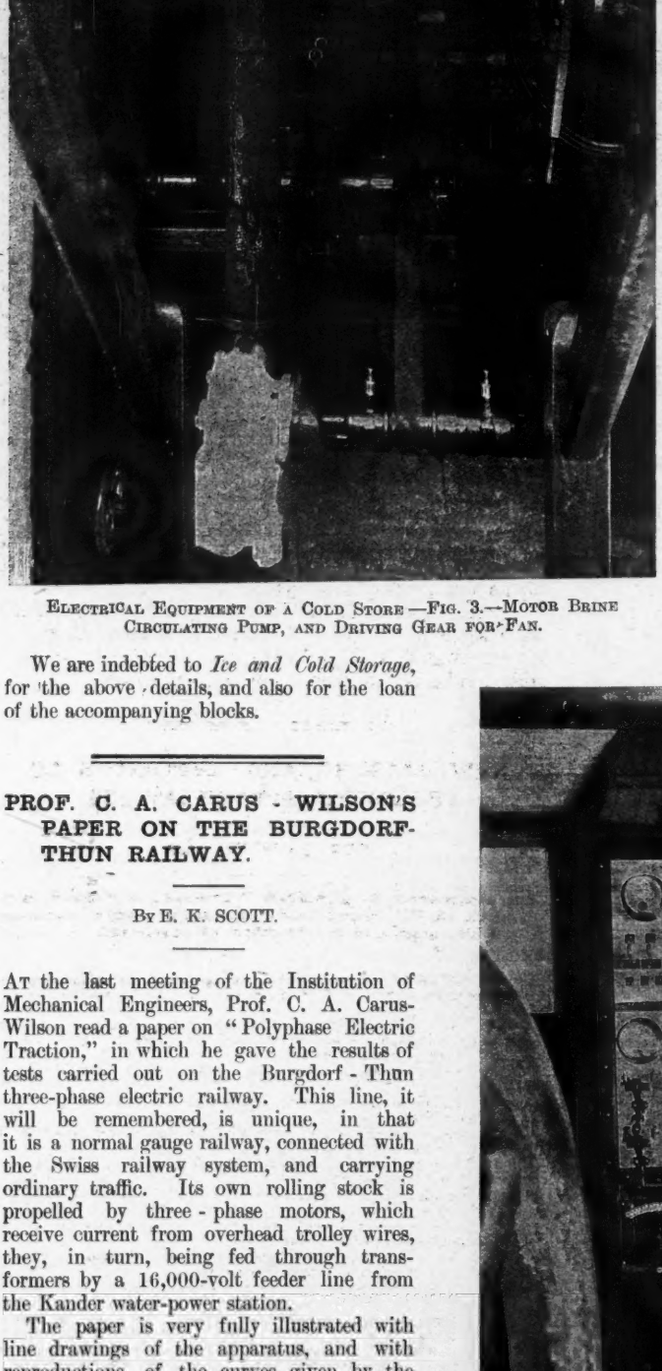


Fig. 2.—Motor Driving Well Pumps.

The electric motors were supplied by Messrs. Turner, Atherton & Co., Ltd. (successors to John Turner & Son), of Denton, and the wiring and switchboard work were executed by Messrs. P. C. Middleton & Co., Ltd., of Aberdeen.



Electrical Equipment of a Cold Store.—Fig. 3.—Motor Brine Circulating Pump, and Driving Gear for Fan.

We are indebted to *Ice and Cold Storage*, for the above details, and also for the loan of the accompanying blocks.

PROF. C. A. CARUS-WILSON'S PAPER ON THE BURGDORF-THUN RAILWAY.

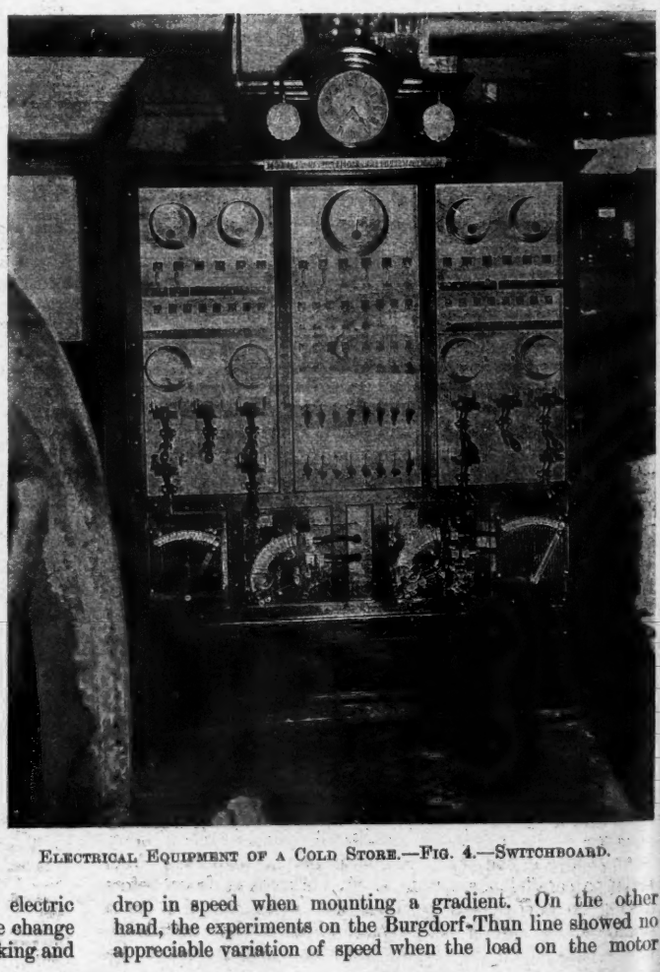
By E. K. Scott.

At the last meeting of the Institution of Mechanical Engineers, Prof. C. A. Carus-Wilson read a paper on "Polyphase Electric Traction," in which he gave the results of tests carried out on the Burgdorf-Thun three-phase electric railway. This line, it will be remembered, is unique, in that it is a normal gauge railway, connected with the Swiss railway system, and carrying ordinary traffic. Its own rolling stock is propelled by three-phase motors, which receive current from overhead trolley wires, they, in turn, being fed through transformers by a 16,000-volt feeder line from the Kander water-power station.

The paper is very fully illustrated with line drawings of the apparatus, and with reproductions of the curves given by the recording instruments, &c.

The two most important points in connection with railway working are frequency of train service and punctuality. The first is governed by the question of whether trains are worked by separate locomotives as in steam traction, or whether each unit of a train has its own propelling power, as is possible only with electric traction. If ever electric railway working replaces steam on a large scale, the change will come not so much because of more efficient working and higher speeds, but because it will be possible to give improved service to the smaller towns by running short trains, or maybe single cars, at frequent intervals, instead of as at present running cumbersome trains driven by steam locomotives at intervals of several hours. With regard to punctuality, Prof. Carus-Wilson points out that the breaking up of railway traffic into smaller units would have a marked influence on the punctuality, because the more continuous and uniform movement of the traffic would enable the employés of the line to be more uniformly occupied. The infrequent arrival of long trains with large numbers of passengers, and corresponding quantities of luggage, gives place to frequent arrivals of single cars, thus enabling the existing staff to handle the traffic with greater promptitude and facility, especially when temporary increases of traffic have to be met. Punctuality is, however, also governed by the influence of increase of traffic on the actual running speed of the trains, particularly on lines where the grades are at all considerable, and in this polyphase motors show to great advantage over the continuous-current motors, because they run at practically constant speed, *entirely independent of load or grade.*

The series-wound continuous-current motor, as generally used for electric traction, has a large reduction of speed with heavy loads. Thus a case is given in the paper where a 16-ton car, running light, has a speed of 24 miles an hour, whereas when hauling seven 16-ton trailers, the speed dropped to 15 miles an hour, there being also an extra drop in speed when mounting a gradient. On the other hand, the experiments on the Burgdorf-Thun line showed no appreciable variation of speed when the load on the motor



Electrical Equipment of a Cold Store.—Fig. 4.—Switchboard.

ar was increased from 32 to 68 tons, and only 2 per cent. all when a 50-ton train ran from a level up a grade of 1 in 40. A railway equipped with polyphase motors can carry a temporary increase of traffic without influencing in any appreciable degree the scheduled speed, the only exception to this statement being that an increase of load affects the time of starting. In order to settle this point, Prof. Carus-Wilson made very elaborate acceleration tests, for a detailed account of which the reader is referred to the paper in question.

It happens that the South Side Elevated Railway at Chicago, which is equipped on the Sprague multiple unit system, compares very nearly, as to size of cars, &c., with the Burgdorf-Thun Railway, and in Table I. are given particulars of tests made on the two railways. It will be seen that the continuous-current equipment can get up a speed of

Name of railway ...	South Side Elevated Railway, Chicago.	Burgdorf-Thun Railway.
System	Continuous current	Three-phase current.
Voltage	600	750
Control	Series parallel	Rheostatic.
Motors on each motor car.	2	2
Weight of motor ...	...	1,600 kg. = 1·56 tons
Diameter of driving wheel.	33 inches	1,020 mm. = 40 inches
Gear ratio ...	65 spur / 22 pinion = 2·95	664 mm. / 224 mm. = 2·96
Horse-power of each motor.	52 H.P. at 500 volts	64 H.P.
Number of poles ...	4	8
Total weight of motor car.	19 tons	32 tons
Number of passengers...	40	66
Weight per passenger...	1,050 lbs.	1,070 lbs.
Max. speed miles per hour.	24	24
Weight of train per motor.	9·5 tons	8 tons
Acceleration, feet per second per second.	0·95	1·17
Time to full speed, seconds.	37	30
Max. KW. input per motor.	75	53
Watt-hours per ton ...	39·5	45·1
Watt-hours per motor...	375	361

24 miles per hour, with 39·5 watt-hours per ton in 37 seconds, as compared with 45·1 watt-hours in 30 seconds with the three-phase motors. Thus the continuous-current motors use 87 per cent. of the energy used by the three-phase motors, while the three-phase motors get up full speed in 81 per cent. of the time taken by the continuous-current motors. The reduction of energy in the continuous-current motors is due to the use of the series-parallel controller. Comparing the maximum power input in the two cases, it will be seen that whilst the continuous-current motor takes 75 KW., the three-phase takes 53 KW., or only about 70 per cent.

In connection with the quicker getting up to full speed of the polyphase motors, it is interesting to note that this may be partly due to the fact that the magnetic circuit of the polyphase motor is entirely constructed of charcoal iron of high permeability, whilst cast-steel forms a considerable portion of the magnetic circuit of a continuous-current motor, and it thus takes some little time to acquire its magnetism.

The regulation of speed of the three-phase motor is, of course, entirely rheostatic, with resistances in the rotor circuit, whereas with the continuous-current motor, regulation is partly by resistances, and partly by arranging the two motors in series or parallel. The superiority of the continuous motor in this respect of series paralleling has been somewhat overstated, seeing that it is only for speeds less than half the full speed that the motors can be put in series. Again, the amount of acceleration which is possible, without inconvenience to the passengers, may be very considerable if there is no *change* in the rate. For example, in switching from series to parallel, the current is often allowed to droop before taking on the parallel position, and there will thus be a change in the rate of acceleration, which is very noticeable to the passengers. An expert motorman usually makes the change at the right moment, but, of course, there is always the possibility of his not hitting it off. On the other hand, with plain rheostatic control there is never any doubt, the acceleration rate must be absolutely gradual until full speed is reached.

In regard to the ability of the three-phase motor to take overloads, Prof. Carus-Wilson points out that the "breakdown" load of a well-designed motor is usually 1½ times to twice the rated maximum safe-working load, a limit which would fairly cover any temporary overload in practice. As a matter of fact, the polyphase system admits of the whole installation from generator to motor being worked without any kind of safety or automatic cut-out, even fuses being dispensed with if suitable generators are used. Under these conditions an interruption in the train service, due to overload, is far less likely to occur than with the continuous-current system, where safety fuses and automatic cut-outs are essential.

In conclusion, the writer cannot do better than quote Prof. Carus-Wilson's summing up. He says: "The tests described were made with the object of ascertaining the ability of polyphase motors to get up speed under ordinary conditions of railway service, and the economy obtainable in so doing, when compared with that observed with the best continuous-current motors. The results of the tests go to show that polyphase motors are admirably adapted to getting up speed, and that the acceleration can be maintained uniform up to full speed. A comparison of the results with those obtained with one of the best and most complete continuous-current equipments, shows that there is very little difference between the two in economy of starting. The continuous current motors have a slight advantage in the amount of energy expended, while they occupy a longer time in reaching high speeds, and require larger maximum power inputs than the polyphase motors."

Altogether, Prof. Carus-Wilson's paper is most interesting and instructive, and the Institution of Mechanical Engineers is to be congratulated on having had so valuable an electrical communication read at one of its meetings.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

19,294. "The B.B. improved semi-dry storage battery or accumulator for storing electrical energy." H. K. P. Barham and E. N. Bambury. Dated October 29th.

19,331. "An improved process and means for the production of electro-depositing of high relief and undercut designs." G. Roselier and B. Dellagana & Co., Ltd. Dated October 29th.

19,334. "Improvements in automatic switches." W. E. Wilson. Dated October 29th.

19,371. "Improvements in starting switches for electric motors." E. Norris. Dated October 30th.

19,383. "Improvements in and connected with electric arc lamps." F. R. Boardman. Dated October 30th.

19,386. "Improvements in automatic time switches." C. H. Offord and S. Jevons. Dated October 30th.

19,393. "Improvements in apparatus for electrically treating air gases and gaseous mixtures." R. J. Yarnold. Dated October 30th.

19,394. "Improvements in lampholder switches for electric lighting." G. H. Chard. Dated October 30th. (Complete.)

19,395. "An anti-vibration base-frame for motors, dynamos, and other machinery." G. Middleton. Dated October 30th.

19,416. "Improvements relating to telephone call recorders." H. D. Stroud. Dated October 30th. (Complete.)

19,436. "Improvements in electric arc lamps." C. Schuster. Dated October 30th. (Complete.)

19,444. "Improvements in arc lamps." G. C. Marks. (Continentale Jandus Electricitäts A. G. Société Anonyme, Belgium.) Dated October 30th.

19,448. "A new or improved method of controlling the action of electro-motors." C. A. Carus-Wilson. Dated October 30th.

19,449. "A new or improved method of controlling the action of electro-motors." C. A. Carus-Wilson. Dated October 30th.

19,451. "Improvements in and relating to electrical condensers." G. F. Mansbridge. Dated October 30th.

19,470. "Improvements in electric switches." Crompton & Co., Ltd., and S. L. Brunton. Dated October 31st.

19,471. "Improvements in electrical switches." Crompton & Co., Ltd., and H. W. W. Dix. Dated October 31st.

19,482. "Improvements in electric ignition for internal combustion motors." W. J. Crossley and C. J. Atkinson. Dated October 31st.

19,486. "Improvements in electric clocks." F. W. Leake. Dated October 31st.

19,494. "Improvements in slot wedges for dynamo-electric machines." The British Thomson-Houston Company, Limited. (H. G. Reist, United States.) Dated October 31st. (Complete.)

19,495. "Improvements in systems of electrical distribution." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (W. Le R. Emmet, United States.) Dated October 31st. (Complete.)

19,496. "Improvements in induction electric motors." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (C. P. Steinmetz, United States.) Dated October 31st. (Complete.)

19,497. "Improvements in automatic circuit-breakers for electric circuits." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (E. M. Hewlett, United States.) Dated October 31st. (Complete.)

19,498. "Improvements in circuit breakers for electric currents." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (E. M. Hewlett, United States.) Dated October 31st. (Complete.)

19,499. "Improvements in systems for controlling electric motors and electrically propelled railway trains." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (F. E. Case, United States.) Dated October 31st. (Complete.)

19,500. "Improvements in electric switches." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (E. M. Hewlett, United States.) Dated October 31st. (Complete.)

19,506. "Improvements in electric arc lamps." F. J. GREEN. Dated October 31st. (Complete.)

19,509. "Improvements in the manufacture and production of solid ends on wire ropes, electrical conductors and the like." T. J. MCTIGHE. Dated October 30th.

19,511. "Improvements in dynamo-electric and electro-dynamic machines." J. H. St. H. MAWDSLEY. Dated October 31st.

19,512. "Improvements relating to electric circuit-breakers or switches." H. H. LAKE. (McElroy-Grunow Electric Railway System, United States.) Dated October 31st. (Complete.)

19,516. "An improved device for regulating engines for driving electrical dynamos and the like." J. R. FRIKART. Dated October 31st.

19,554. "Improvements in and relating to combined telephone and sound telegraph apparatus." C. E. LJUNGMAN. Dated November 1st. (Complete.)

19,570. "Improvements in or relating to overhead trolley wires or conductors for electric traction overhead electric cables or the like." A. W. HANCOCK, J. LEIGHTON, and R. HACKING. Dated November 1st.

19,576. "Improvements in electric switches, and in ship's telegraphs, railway signalling apparatus, and the like." A. L. A. C. D'ARLINCOURT. Dated November 1st.

19,588. "Improvements in automatic electrical switches, and circuit breakers." J. BOOKER and P. SUMNER. Dated November 1st.

19,594. "Improvements in alternating current transformers or economy coils." J. L. DAVIES. Dated November 1st.

19,595. "Improvements in or connected with arc lamps." J. L. DAVIES. Dated November 1st.

19,612. "Improvements in or relating to the renovating of electric incandescent lamps." A. J. BOULT. (La Saymar Ommium Industriel D'Electricite Societe Anonyme, France.) Dated November 1st.

19,616. "Improvements in electric railway cars or vehicle trolleys." G. PRESCOTT. Dated November 2nd.

19,623. "An improved gas tight fuse, and junction box for electric cables." P. J. E. KENNEDY and H. C. READING. Dated November 2nd.

19,658. "A new and improved process of insulation of electric wires or cables." M. HANKIN. Dated November 2nd.

19,672. "Improvements in wireless telegraphy and in apparatus therefor." E. PILSOUDSKY. Dated November 2nd.

19,674. "Improvements relating to electric railways working on the surface contact system." H. H. LAKE. (W. M. Brown, United States.) Dated November 2nd. (Complete.)

19,736. "Improvements in de-cohering apparatus for wireless telegraphy." J. ZENNECK and Prof. BRAUN'S Telegraphie Geselschaft mit Beschrankter Haftung. Dated November 3rd.

19,737. "Improvements in signalling by means of electric waves." J. ZENNECK and Prof. BRAUN'S Telegraphie Geselschaft mit Beschrankter Haftung. Dated November 3rd.

19,754. "Improvements in and relating to key sockets for incandescent electric lamps." O. D. LUCAS, T. H. MARSH, and A. VANDAM. Dated November 3rd. (Complete.)

19,759. "Improvements in electric traction systems." W. AITKEN. Dated November 3rd.

19,765. "Improvements in electric resistances." W. PITT. Dated November 3rd.

19,766. "Improvements connected with overhead trolley poles used in electrical traction." W. E. ROWLANDS. Dated November 3rd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

7,764. "An improved apparatus for the electro-deposition of metals." J. H. Hope. Dated March 31st, 1898. Relates to electro-plating in apparatus of the barrel type. The hexagonal barrel is provided with one removable section, for charging and discharging the articles to be plated, and with a screw plug in another section for draining off the liquid. In the barrel there is carried by wood blocks in such a manner as to be easily removable a central cylindrical or bar anode which is covered by a non-conducting gauze, such as canvas. A number of longitudinal conducting strips are secured to the inside of the barrel, and are connected together at each end by connecting rings. The barrel is carried by external shafts which are rotated by any means. The connecting ring holding the conducting strips is connected by a bolt passing water-tight through the end of the barrel, and by a wire and conducting plate to a bolt which is electrically connected with the conducting periphery of a non-conducting rotating drum upon which the brush contact bears. The brush contact is connected to the negative wire. The anode is similarly connected to the other wire. The provisional specification states that nickel, copper, brass, gold, and silver, may be deposited by the use of the apparatus. 4 claims.

8,607. "Improved electric arc lamp." J. T. Tschierot. Dated April 26th, 1898. The upper carbon of a clutch lamp is carried by a tube which slides in a sleeve and on a rod secured to the frame. A clutch bored to slide freely on the tube carries the core of a shunt solenoid and is supported near the core by a spring. Feeding is effected by the core and clutch being drawn down until the clutch rests on the sleeve and frees the tube. An adjustable screw limits the upward movement of the clutch. The lower carbon is carried by a tube which slides through an insulating sleeve and is hung by a cord passed over pulleys to the tube. 2 claims.

11,326. "Improvements in adjustable cord reels for electric leads and other similar purposes." W. H. Sturge. Dated May 18th, 1898. An automatic cord reel consists of a loose bobbin through which the cord is passed and which is connected to a supporting tube by a coiled spring. The tube is screwed into a projection in one half of a spherical case and locked by a nut. Cord guides are secured between the parts of the case. Before the cord is applied the bobbin is turned on the tube to wind the spring sufficiently to support the weight which is to be supported and the bobbin is then held temporarily by a screw engaging an arm of the tube till the cord has been passed through a hole in the bobbin. The apparatus is applicable for taking up flexible leads supporting electric lamps and for other purposes. 1 claim.

12,731. "Improvements relating to electric telegraphs." A. Muirhead. Dated June 7th, 1898. Cable circuits for submarine working are provided with inductance coils and condensers in series with the cable and artificial cable. The receiver may be of any type. The transmitter, preferably of the form described in Specification 5,508, 1894, or 11,069, 1894, is shunted by an inductance, both being connected to the arm of a balancing rheostat. In a modified arrangement the position of the receiver and transmitter may be reversed, the shunt being divided and the two halves placed between the cable and earth and the artificial line and earth. In the provisional specification the rheostat is stated to be wound partly with inductive and partly with non-inductive resistances. The artificial cable may also be partly formed of alternating sections of condensers and inductive resistances. 5 claims.

12,784. "Improvements in electrical rheostats and resistances." L. J. Steele. Dated June 8th, 1898. A resistance is made by coiling metal strip into a helix, and forming this into a larger helix, which again may be formed into a still larger one. The helix thus formed may be carried by two terminals. In the second coiling a flexible insulator may be used as a core which may afterwards be coiled with the wire on it to form a large helix, or the coiled wire may be laid in a helical groove in a fluted insulating cylinder, and mounted in a casing which is provided at one end with a rotatable switch, and a number of contact studs. These are connected by metal strips laid in the flutings of the cylinder with different parts of the helix. 5 claims.

13,308. "Improvements in or relating to hammers or tappers actuated electrically." C. Turnbull, jun. Dated August 26th, 1898. Vibrating electrically-actuated hammers for striking bells, for dentists' use, &c., are so constructed that the magnet continues to be excited until the armature carrying the hammer is arrested by the magnet or by a stop. The invention is shown applied to a bell. The hammer is attached to the armature by a spring. The circuit is arranged, and is broken between the contacts by the continued movement of the hammer owing to its inertia after the armature has been arrested. 2 claims.

13,475. "Electric meters." B. J. B. Mills. (T. A. Edison.) Dated August 29th, 1898. Relates to quantity meters. A registering electrolytic meter has a beam supported on knife edges and provided with a weighted arm. It carries at its ends, by knife edges and ivory insulating rings, the inner electrodes of two cells. These are preferably circular. The outer electrodes are supported clear of the containing jars by rods permiting centreing, and are connected together. The two cells are used in series, so that one inner electrode becomes lighter as the other becomes heavier, and the beam thus tilts until a finger on it releases one of the two arms of an escapement of weight-driven counter, and engages the other. A crank on the escapement shaft at the same time rocks a forked switch arm which moves from one of two contact springs to the other, thus reversing the current through the two cells, so that the movement is repeated at intervals. The contact surfaces are gold plated. The main circuit through the meter is by a parallel resistance, half of which is in use at one time, the movable electrodes being connected respectively to the middle of the main resistance and to the switch arm, and the two springs to the ends of the main resistance. A temperature compensating spool is in circuit with the cells. Copper or amalgamated zinc electrodes may be used in sulphate solutions, or silver electrodes in nitrate or cyanide solutions, or in hydrochloric acid, depositing metal, or forming and reducing chloride of silver on the electrodes. A layer of paraffin oil, or other stable inorganic non-miscible liquid is placed on the solution to prevent evaporation or creeping. Connections with the movable electrodes and switch arm are made by flexible non-elastic metal strips to avoid surface contacts. The glass jars are coated externally with amyl-acetate collodion, by repeated dipping and drying, to prevent leakage if they crack; the supporting-wires of the movable electrodes are protected similarly. The parts are supported by the back of a box having a front with a window to show the counter dials. A lamp is connected between the arms by a thermostatic strip when the temperature approaches freezing point. The meter may be used for measuring alternating current, this being passed through a resistance strip reduced in cross-section at a part where a thermopile is attached to it; this is provided with middle and end connections, by which a proportional continuous current is obtained in either direction for the electrolytic cells. 8 claims.

13,522. "An improved electrolytic apparatus for the production of alkali." W. Thomson. Dated August 30th, 1898. Relates to making alkali by the electrolysis of sodium chloride or other salt, using a moving mercury cathode. A shallow trough has a central dividing partition, and a number of low transverse partitions and barricades. Passages are made under the partition so that the thin layer of mercury, which covers the bottom of the trough, can circulate. The trough may be slightly inclined from the inlet to the outlet. Brine is introduced into one cell and water into another above the mercury. Carbon anodes are used in the first cell which is provided with a gas-tight cover to collect the chlorine given off. In this cell sodium amalgam forms. In the other cell the amalgam is decomposed, mercury re-forming, and alkali and hydrogen being liberated. This cell is provided with a corrugated iron cover, supported in the water just above the mercury on glass or earthenware supports (which may be the tops of the partitions and barricades), and metallically connected with mercury in the trough. This mercury is connected with the negative electrode and communicates with the mercury in the other cell. By this means the decomposition of the amalgam is facilitated. The mercury in the last pool is slightly deeper than the others, is raised by a mechanically-operated ladle and delivered to a trough from which it flows back to the first pool. To discharge the apparatus, conical rubber corks, which plug up holes bored upwards through the bottom to the passages are withdrawn. These corks are all carried by a transverse bar, which can be raised and lowered within guides, so that all the corks may be withdrawn or replaced simultaneously. 1 claim.

13,552. "Improvements relating to motor trucks for electric and other railways or tramways, and to driving gear therefor." G. J. Capewell. Dated August 30th, 1898. Relates to trucks or under frames for electric or other railway or tramway vehicles, and to the driving gear for connecting the motor to the wheels. The under-frame consists of two rectangular parts held together by bolts passing through elongated holes so as to allow a certain freedom of movement of the two parts of the frame about the pin. Each half of the frame is supported on an axle driven by an electric motor through friction gearing. The shaft of the motor is provided at opposite ends with friction wheels which may be made to gear with friction wheels on the axle, giving two ratios of transition. The motor is mounted on a framework which is capable of a small horizontal movement towards and away from the axle and also of a slight oscillatory movement about a vertical axis so as to bring either pair of friction wheels into gear. The frame is pulled away from the axle by springs and either end can be moved towards the axle by a bar with wedge-shaped ends, engaging inclined faces on the framework. The bar may be moved in either direction by a lever forcing one or the other pair of friction wheels into gear. The object of the double hinging of the base of the motor is to cause the friction wheels to jamb more closely together as the tractive resistance increases. The tangential force at the point of contact of the friction wheels tends to turn the motor about one or other of the pivots according to the direction of driving, the effect in either case being to bring the shaft of the motor nearer the axle. Each axle may be provided with two pairs of wheels, one pair being ordinary flanged wheels for running on the usual rails, and the other being flangeless, and formed with a flat tread for running on a special track. These wheels are built up of a number of discs of wood held together by iron plates and provided with a tread of cushioning material. The track for the flangeless wheels is formed of flat timbers set outside and a little higher than the ordinary rails. The truck is retained on the track by side wheels engaging side rails, which may also serve as electric conductors, being protected in that case by a shield. Lifting is prevented by wheels running under the side rails. The side rails are supported by bent angle irons attached to sleepers placed between the main rails intermediately to the ordinary sleepers. 9 claims.

13,582. "Improvements in induction motors." R. Bellfield. (E. G. Lamme.) Dated August 30th 1898. In an induction motor, the rings or plates which connect together the ends of the conductor bars forming the secondary circuit, are furnished with radial blades which produce air currents for the purpose of ventilation. The laminated cores of the primary and secondary members are provided with ventilating-channels, those of one member being in the same plane as those of the other. Alternate blades on the connecting-rings are formed with projections, which engage with shoulders on the outer flanged portion of the spider. The conductor bars are connected to the rings by bolts, provided with spring washers to permit of expansion. 4 claims.